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ILLUSTRATED

VOL. I MARCH 1900 No. 6

The United States Industrial Publishing Company

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A Midwinter Run

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The Automobile
MAGAZINE

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The Street Car of the Future

By Waldon Fawcett

IN business, as in warfare, contestants seldom evidence great care in estimating the strength of an opponent they do not fear. That the electric street railway interests of America are focusing upon automobilism a fierce light of investigation is, therefore, of considerable significance. It will be remembered that when the interurban electric lines a few years ago commenced their inroads upon the province which had up to that time been the exclusive property of the steam roads, the projectors of the former asserted that there was a place for both, and that by reason of its work as a "feeder" the electric interurban system would prove a valuable adjunct to its predecessor in the transportation field.

Now, a third factor is steadily and rapidly advancing to claim a place in the field, and also to aid in its development. All that was urged in favor of the trolley system in its relation to the steam road may be claimed for motor vehicles in their influence upon both. The new mode of locomotion will assuredly draw to some extent from the patronage of each of its competitors—principally, of course, from the electric lines—but, on the other hand, it will, quite as surely as did the interurban trolley, open up new lines of communication which will bring revenue to all transportation interests in greater or less degree.

To take up first the automobile in its relation to electric lines in the cities, it may be pointed out that its chief advantages will be found in speed and comfort. The displacement of the antiquated Fifth avenue stages in New York City by autocars

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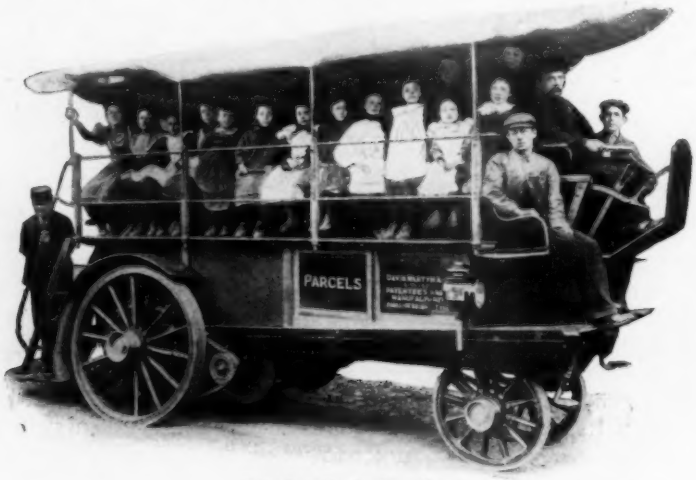
of an approved type will serve to illustrate admirably one phase of the possibilities referred to. There will probably always remain in every principal American city at least one or two residence streets of considerable length from which street cars will be debarred. Some system of public conveyance for such thoroughfares is an essential, not only to meet the requirements of the residents, but also in view of the fact that such streets being favored with the handsomest residences are much sought by tourists.

Had an effort been made to design a vehicle for just such service nothing more completely filling the requirements than the



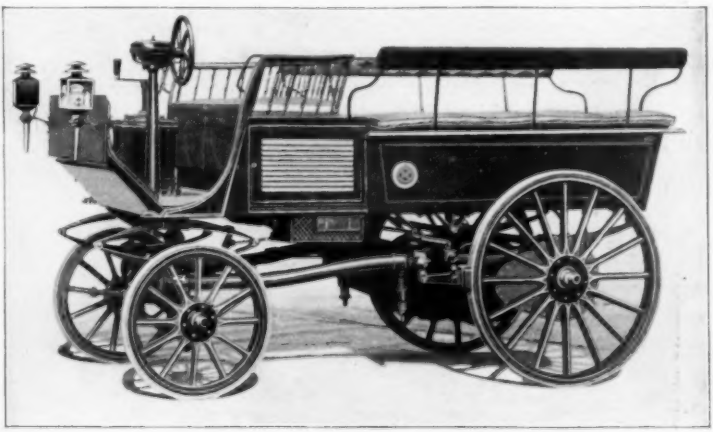
London Park Omnibus

automobile could be found. The absence of steel tracks and the minimum of noise constitute its chief qualifications, but there are also others which would cause it to be looked upon rather as an ornament than a detriment to exclusive residence districts.

While upon this subject mention must be made of another sphere of usefulness quite as important as any in which the horseless vehicles will come into more direct competition with the street cars. This is the service in parks and boulevards. Of late years American cities have broadened immensely the scope of their park systems, and there is an almost universal tendency to connect the various public playgrounds by boulevards, after the plan, the advantages of which have been so conclusively

demonstrated in Chicago and Cleveland. All considerations preclude the possibility of allowing street cars to gain entrance to any part of these pleasure highways, and yet the old carriage or omnibus system, long an eyesore in many of our American parks, is totally inadequate to meet the demands of that portion of the public which wishes to inspect a park system without devoting several days to the task. For such a service, on the other hand, the combination automobile omnibus and street car recently designed will have numerous qualifications and few disadvantages.

In the open field the automobile must rely for its share of the business of carrying the public between homes and shops and



Berlin Park Stage

offices on the advantage afforded by greater speed and comfort. The former must be primarily considered, inasmuch as any means of reducing the time of transit is bound to appeal strongly to mankind in general, a fact attested by the patronage accorded to the elevated railroads in the larger cities. It will also be found practicable to operate automobiles in sections of cities where excessive grades and other engineering obstacles would stand in the way of the establishment of an electric railway system.

In the suburban service there is a distinct niche for the motor vehicle. There are in the neighborhood of every city numerous districts rather too sparsely settled to make a suburban electric line a paying investment, and yet with a population sufficient to

net a handsome revenue to a carefully conducted automobile line Especially will this be true in the smaller cities ranging in population from thirty-five to one hundred thousand. In many such the suburban car service is limited in the extreme in scope, largely by reason of the fact that a single company controls the entire electric railway system of the place and has never been stimulated by competition. In such a field the schedule for automobile operation can be gauged very accurately to the volume of travel, and there will be, of course, no heavy first outlay for roadbed, rails and overhead wires.

Certainly the prediction may be made, without any danger of characterization as optimism, that the automobile will ultimately supplant every other form of conveyance on those routes to which a majority of the travelers who traverse them are attracted by the scenic possibilities. This is attested by the great demand for automobiles which has sprung up at all the leading summer resorts and by the project of American capitalists to establish an automobile line across the Island of Porto Rico, as well as numerous other similar propositions.

French Hotel Bus

The Street Car of the Future

American Hotel Bus

The branch of the service for which the automobile has yet to demonstrate its adaptability is the interurban. Many street railway magnates, while conceding that the motor vehicles are admirably adapted to all forms of public conveyance in the city, assert that they would prove impracticable for the runs of from twenty to fifty miles which would be required on interurban routes. The credence given to these representations is due largely to the lack of success which has attended some of the long distance automobile trips undertaken in the United States during the latter half of 1899. That the objections made are, however, unfounded, is proven by the splendid records for long tours made in England and France.

An exhibition which will further demonstrate the capability of the automobile for just this class of work will be found in the thousand mile tour for motors of every description to be held late in the spring, traversing a zig-zag route from London to Edinburgh. The award of gold, silver and bronze medals will serve to establish a relative rating of merit for the different machines from the standpoint of suitability as roadsters.

A type of vehicle which, with certain modifications, would seem to be admirably adapted to interurban service, is the combined street car and omnibus which has recently been introduced in several German cities. The vehicle is designed for use as an ordinary automobile on streets where there are no tracks and yet is gauged to run on the tracks of electric railways, where such

French Colonial Stage

exist. A distinguishing feature of the design is the location in front of two guide wheels. These are lifted up during the passage of the vehicle through streets without tracks, but serve to guide it on the tracks of electric lines. The automobile is so constructed as to be able to turn into very narrow streets.

In Berlin an Automobile Stage has been running during the last six months regularly over that stretch of the city lying between the Stettin R. R. Station and the Kreuzberg. The daily distance covered by this vehicle is 72 kilometres.

Reckoned by Watt hours the cost per kilometre is 0.6 pfennigs, which makes 2 cents per kilometre, counting a kilo-Watt hour at 16 pfennigs.

This omnibus weighs 7,100 kilograms, including the weight of 30 passengers, conductor and motorman. Without passengers the vehicle weighs 4,850 kilograms, including its electric batteries. The omnibus measures, according to continental standards, 3.6 in height, 4.3 in length, 3.2 axle distance, 1.7 in width, 1.3 wheel width. The height of the front wheels is 1.07.

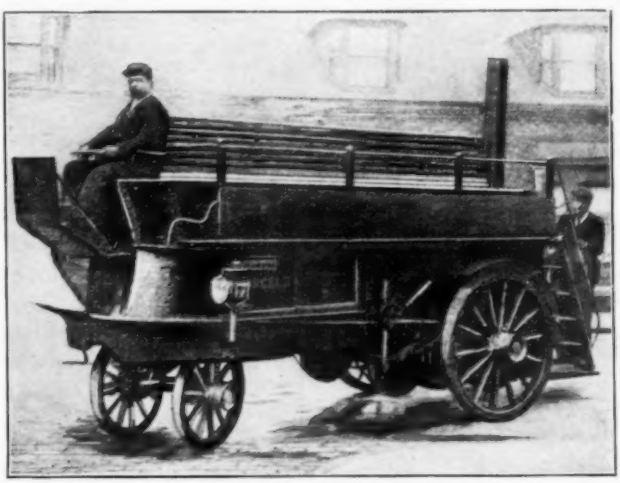
and that of the hind wheels 1.2. The steering wheel has a diameter of 540 milimetres, and the gear is set at one to eighteen.

Power is transmitted through two motors of five horse-power each, at 160 volts and 30 amperes, giving approximately 450 revolutions per minute.

The results accomplished by this omnibus seem to have proved unusually satisfactory. Though the wagon has been fully laden with passengers day after day, the Berlin newspapers report that no serious breakdown has ever interfered with the regular schedule of the new automobile line.

Through the courtesy of the builders, Messrs. Lange & Gutzeit, of Berlin, we are able to give herewith an illustration of another large electrical omnibus they have lately constructed for the Neue Berliner Omnibus Gesellschaft. (See page 569.)

This vehicle has accommodation for twenty-eight persons, including the driver—two on the front platform, twelve inside, and fourteen outside. It is driven by two 4 horse-power electromotors, geared by large spur wheels to the rear axle. The electrical energy is supplied by a battery of Tudor accumulators slung in a box underneath the body of the car. Unfortunately, we are unable to give the number or electrical capacity of the accumulators, but the makers inform us that a run of 12 kilome-



Martyn's Steam Omnibus

tres can be made on one charge and that the battery can be recharged in a very short space of time.

The vehicle is provided with both electrical and mechanical brakes, which can pull the vehicle up in a very short distance, even when traveling at full speed. The steering is effected by a vertical hand wheel connected with the front road wheels. The stage, we learn, has been in use in the German capital for over a month, and, according to the makers, has given every satisfaction.

Messrs. Lange & Gutzeit are at present engaged on the construction of a 'bus on similar mechanical lines, but having no outside seats. It will have accommodation for eighteen passengers, and is intended for service in small towns.

Coulthard's Colonial Steam Bus

An interesting comparison of the cost of operation of trolley cars and automobiles has been made by an authority on that subject. According to this estimate the total cost of installing and maintaining a five-mile trolley line over a fairly level road amounts to no less than fifteen thousand dollars a mile. This includes a small electric power plant and a single track with turn-outs, equipped with ordinary wooden telegraph poles. In addition to this there would be the cost for at least two cars carrying from 35 to 40 passengers each. This is $6,000 per car. The running expense of such cars amounts to sixteen dollars a day, or more in places where labor and fuel come high.

The installation and maintenance of such a small trolley road, in other words, would call for an investment of about $375,000, to which should be added the first cost of $75,000 for the tracks and $12,000 for the cars.

Traveling at the rate of thirty miles an hour a trolley car, in making twenty-minute trips over its five-mile course, would stand at rest for at least half of the time. The maximum carrying capacity under such conditions would be 2,800 passengers a day for every twelve hours. To meet its total running expense of $63 per day, therefore, each car would have to carry an ave-

Compressed Air Omnibus

rage of more than three-fourths of its maximum capacity, simply to meet expenses. Needless to state this proportion between income and outlay would never commend itself to any serious business man.

An automobile omnibus capable of carrying one-half the number of passengers of a trolley car would require a motor of at least fifteen horse-power. For a new vehicle equipped with such a motor $5,000 would be a good price. A motor of equal horse-power capable of adjustment to any vehicle, such as the Vollmer fore-carriage, or other similar devices now used in Europe, could be secured for less than $1,000. Taking the maximum price of

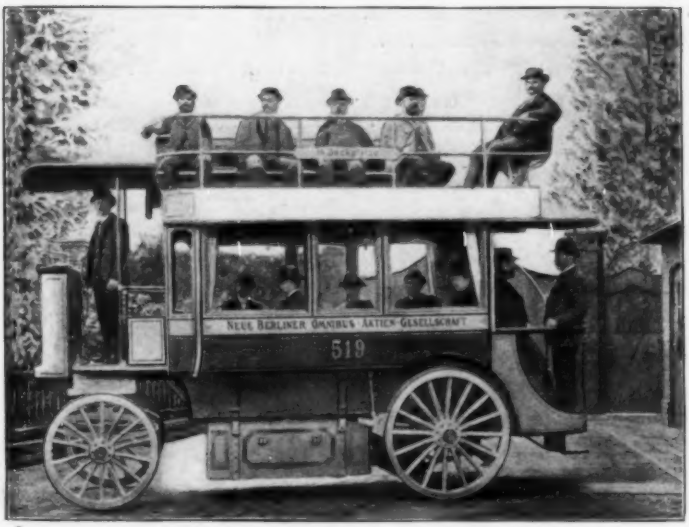
$5,000 as the basis, however, would make the total investment for an automobile omnibus line covering the same distance $30,000, as against $87,000 for the trolley line. This estimate provides for at least half a dozen omnibuses to carry the same number of passengers as two trolley cars. Thus only could the difference of carrying capacity in traveling time be fairly offset.

Allowing five years of service for each automobile, gives the maintenance cost of $6,000 a year, as against 12,370 points as against the trolley. With the initial cost of $30,000 the total investment for the motor omnibus system of equal carrying capacity and route mounts up to $164,000, as against $375,000 for the trolley line.

If other things are taken into consideration, such as the probable income from a light freight and package service and frequent economies in cost when superfluous automobiles are laid off at times when traffic is light, it may be safely assumed that such a motor omnibus system could be installed and operated at an outlay of about one-third of that required for a trolley line of corresponding value.

These figures show plainly that an automobile omnibus service designed as a feeder for some railway or street car already in existence would be a far cheaper investment than an extension of the older existing systems. Similarly, automobiles could be

German Electric Autocar



German Electric Stage

thus operated in country districts or as feeders to prosperous summer resorts and sanitariums, where a trolley line could only be a dismal failure.

Street railway men have long declared that the average American is in too much of a hurry to take time to climb to the second story of a double-deck car, but there is every reason to believe that a type of automobile, built after the fashion of a tallyho or an omnibus, with seats on top, will ultimately find favor with suburban and long distance passengers. The possibilities in the matter of speed may be realized from the recent record of an English machine which made the journey from Coventry to London, a distance of 92 miles, in four hours, an average of 23½ miles per hour.

The cheapening of the motor vehicle will naturally prove an important factor in the extension of its use as a competitor of the street car. Indeed, it will reach its fullest development in this direction only after the price of an autocar is approximately that of a street car fitted with an electric motor. Once started, the encroachments of the automobile on the field of municipal transportation will be rapid. The new vehicles may also be expected to displace street cars in many auxiliary services, such

as the conveyance of the mails and the transportation of farm products in the rural districts.

The following is a conservative view of one of the greatest railroad promoters of America:

"I do not think that any sort of traction that does not run on rails and that does produce, or carry in condensed form, its own motive power, will ever be a competitor for railways of any description. The production of power in quantities is the only economical way to produce it, and the resistance to traction on rails is so much less than on the best of roads, that, for regularly carrying large numbers of people, there can scarcely be a comparison.

"I can readily see, however, that there are cases where motor-vehicles would be far more economical than trolley cars. I can also see where they could be used to great advantage in connection with trolley lines. There are many trolley roads that feel the need of feeders and yet find that there is not enough traffic to justify the building of branch lines. The motor-omnibus is the very thing to fill the want. It would be particularly economical where storage batteries were used, as the company could charge the batteries at a minimum cost. In such cases, lines of motor-omnibuses could be used in connection with the regular trolley lines, to advantage, and, when the season was over, the buses could doubtless be utilized elsewhere, or, if not, they could be safely stored and there would be far less loss than with the trolley line.

"Yes; there is, no doubt, a great field for motor-omnibuses. They will prove a great factor in cities, too, but not in direct competition with the street railway lines. It will be their province to operate in the residence streets where it is impossible to get franchises to lay tracks."

TIRE PUNCTURES

According to a contemporary the greatest trouble with the pneumatic tire on heavy vehicles is not caused by puncturing, which accounts for only about 7 per cent. of the trouble, but results from the internal wear of the fibres of the tire, due to the weight. Some tires which have been examined show the fibres of the material reduced to a fine powder.

The New Sport Abroad

(By Our Own Correspondent)

THE new regulations for automobiles imposed by the municipal council of Paris have raised lively protests. Particular objection is made to the rule restricting the speed in the Bois de Boulogne and Vincennes to twelve kilometres an hour, or seven and a half miles. The Automobile Club has issued a circular on the subject, calling attention to the fact that at the meeting of November 28 the committee of the club censured the practice of driving at inordinate speed in crowded thoroughfares as compromising the interests of automobile locomotion by provoking regulations which by their rigor tend to impede the development of the industry. In this censure were included those motorcyclists who, by not using their escape-valves, run the risk of frightening horses by the noise. The committee also regretted the action of the municipal council limiting speed in the parks and expressed the hope that the regulation, if not withdrawn, would not be strictly enforced.

The President of the club, Baron de Zuylen, says the action of the council was due to certain madmen who go at the rate of 60 kilometres an hour simply to make themselves conspicuous. This has caused such numerous complaints, he said, that the council imposed the new regulations. He suggested that certain ways in the Bois be set apart for automobiles as others have been set apart for bicycles and others for riding.

President Loubet has recently become a convert to the automobile. Accepting an invitation to join Count Potocki in a day's shooting at the latter's estate at Le Serray, the Count met the President at the railway station with his automobile. They darted off at a good speed and by the time they had reached the Count's abode the President was enthusiastic over his experience.

A deal of interest has been excited by the reported bet of a young automobilist here in Paris that he can make 100 kilometres in an hour, staking 100,000 francs on the result. It is said that the attempt will be made on the stretch of 70 kilometres between Evreux and Lisieux, where the only heavy grade lies near the middle portion of the road.

It appears that the automobile has not yet diminished the use of horses here in France. Indeed, according to the report of the general inspector of horses, their number continues to increase.

In 1895 there were 2,881,226 horses in the country. In 1897 there were 3,005,541, and in 1898 the horse-population had increased to 3,025,502.

There does not yet appear to be any great boom in automobile manufacturing projects in Great Britain, although contrary to the experience with bicycle manufacturing, the demand is so enormous that there can be no danger of overstocking the market for years to come, and the industry must therefore prove highly profitable. There is considerable quiet activity, however, in the way of new enterprises. One of these is the Yorkshire Motor Car Manufacturing Company, Limited, incorporated with a capital of £50,000 to acquire and extend established concerns in Bradford, Halifax and Hipperholme. Various cycle companies are also going in for automobile manufacturing.

The London Electric Cab Company, which has already invested 1,500,000 pounds sterling in its plant, reports a great advance in storage-battery efficiency. Its latest accumulators comprise forty cells each, with a capacity of 150 ampere-hours. Two sets of batteries are provided for each vehicle. There are five rates of speed beside one for reversing. The motors, of 3½ horse-power, are of the Johnson-Lundell type. The company's station has room for 150 cabs, and there are 80 in service.

The automobile has proved itself useful in distributing war news on Sunday morning in London, when the regular local transit lines are at a standstill. The *Telegraph* and the *Westminster Gazette* place at the disposal of the *Weekly Dispatch* and the *Referee* all the war news received at their offices up to noon and these newspapers then send out, as soon as possible, their latest editions by automobile to all outlying districts, the vehicles being furnished by the Motor Van and Waggon Company, Limited.

A very useful novelty for ladies who fare either by automobile or bicycle is the Claxton Mask Veil, a recent device that is colorless, translucent and practically weightless. Invisible beneath an ordinary veil, it does not interfere with respiration and at the same time protects the face against cold winds as effectually as if the wearer were behind a screen.

The automobile omnibus service in Edinburgh is reported to be a great success, and steps have been taken to extend it by the addition of several new lines. The fare is the same as on the tramways—a penny a mile. The same rates are charged by the automobile lines in Glasgow, Dundee, Aberdeen, Falkirk and other Scottish cities.

Steps have been taken in Edinburgh to organize the Scottish

Automobile Club, affiliated with the Automobile Club of Great Britain and Ireland. At the annual banquet of the latter it is interesting to note that Mr. Shaw Lefevre spoke of a belated movement against automobilism, manifest in the bombardment of the Local Government Board with petitions for further restrictions. Great progress had been made in the three years since the passage of the Light Locomotives Act, he said, though small compared with that made in France. The British demand for vehicles, however, was greater than the supply. He believed a great change was impending; automobilism would not only build up a new industry, but greatly improve conditions in the rural districts.

The Chinese ambassador to Great Britain, Chih-Chen-Io-Feng-Luh, who is making an inspection of the leading industrial centres of the country by order of the home government, to report on what he sees, particularly in relation to goods suitable to the Chinese markets, recently made a visit to Coventry. His party was met at the station by a fleet of automobiles belonging to the Daimler and Motor Manufacturing Companies and taken over the town to visit the various industrial establishments. He and his staff took a special interest in the process of automobile manufacturing. At a banquet in the evening he referred particularly to the automobile industry and said that one could scarcely realize the great future before the trade without seeing a factory. And he said that when the roads in China are restored these vehicles would be introduced in the far East as they are now in the West.

The English Automobile Club proposes to organize for next March a tour from London to Edinburgh and back.

" Ladymobile " is the English word proposed to express what is called a *chauffeuse* in French and *Automobilistin* in German.

An English company is to establish an automobile transit line between the Russian city of Memel and the port of Liebau on the Baltic. It is proposed to have a freight-van towed by the omnibus. The time for the trip will be from six to eight hours.

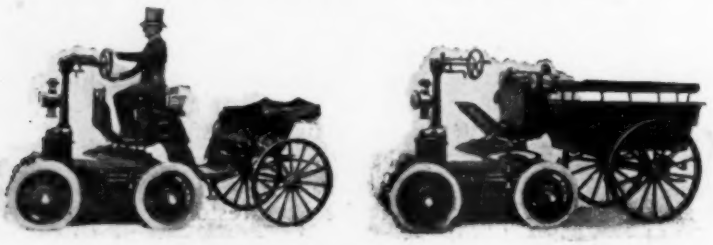
M. Orlovski has written for the *Vélo* an account of his trip from St. Petersburg to Paris by motor-tricycle. He says that the roads about St. Petersburg are miserable; the farther from that capital one gets the better they are. After passing Dvinsk, about 500 kilometres from St. Petersburg, the ways grow fine and one rolls along at the rate of 35 kilometres an hour. With a higher gear he could have made a much greater speed. From Kovno to Warsaw and from Warsaw to the boundary the roads are also good. His greatest trouble was with poor combustion caused by the damp weather and bad benzine. Orlovski undertook the

trip to demonstrate the practicability of Russian roads for the automobile, the Parisian *chauffeurs,* Messrs. Thevin and Houry, sent by the Automobile Club of France to reconnoitre the route, having reported them impracticable at present.

The Russian, Paul Tidemann, has bought a motor-quadricycle here in Paris and intends to make the trip back to Moscow therewith.

Another Russian, Axel Monoinen, proposes to make an automobile trip throughout European Russia in the course of eight and a half months, going from St. Petersburg to Narva, Riga, Kovno, Ssuvalki, Plosk, Kalish, Lodz, Kamenez, Kishinev, Odessa, Nikolajev, Novotsherkask, Zarikyn, Novosdiensk, Uralsk, Perm, Vjatka, Makarjev, Kostroma and Jaroslau, back to St. Petersburg.

In Berlin, automobile liveries have been established with all types of vehicles for hire or on sale. The present charge is four



German Forecarriage Types

marks, or about a dollar, an hour. For a half day the charge is 15 marks; for a day, 25 marks; for a week, 125 marks, and for a month, 400 marks. A good business is done at these rates. Physicians, in particular, use the vehicles very extensively. Each establishment has a well patronized school for instruction in the use of the automobile.

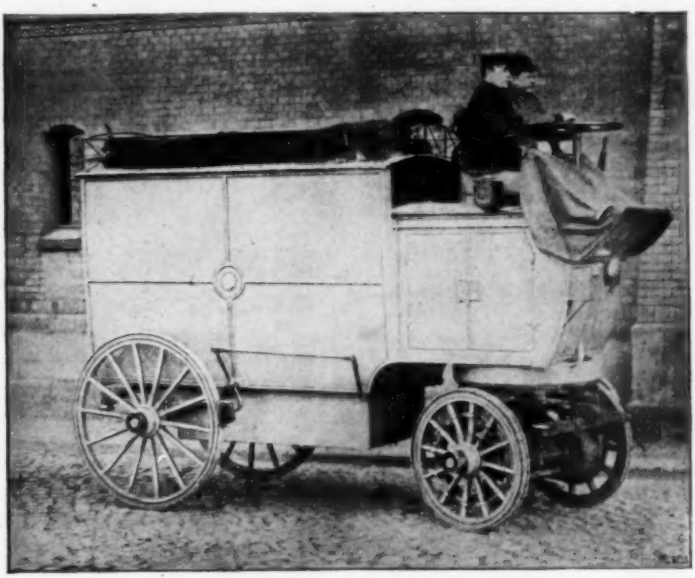
The recent international automobile exhibition in Berlin was a gratifying financial success, although a deficit had been looked for. The receipts were 55,810 marks and the expenditures 43,702 marks, leaving a balance to the good of 12,108 marks. Deducting certain " gratifications " a surplus of at least 10,000 marks is left. The admission receipts, estimated in advance at 10,000 marks, amounted to 31,603 marks, and the rentals for space, also set at 10,000 marks in the preliminary estimate, reached 19,150 marks. It is proposed to hold the next Berlin exhibition in 1901.

In Berlin there are two electric automobiles in the service of

the post-office. One of these, a *Güterspostwagen,* or postal freight wagon, has been in use for several months without serious interruption. The second, a *Paketbestellwagen,* or parcels-post wagon, has also been in successful operation for some time. But when the snow came their use had to be abandoned, together with the *Brief-carriol,* or letter carriage. The trouble was not with lack of power, but with the tires. It appears that, owing to the universal prevalence of asphalt pavement in Berlin, it was thought that steel tires would be sufficient. But when the snow came the traction proved inadequate. Rubber-tired automobiles, however, found no trouble in getting through the snow, and the postal authorities will naturally make the change from steel to rubber as soon as practicable.

The Forecarriage Detached

The German Automobile Club, organized with the Duke of Ratibor as president, has over 200 members. A handsome house on the Sommer-Strasse, Berlin, has become the home of the club.



Berlin Paketbestellwagen

Official and social relations with the automobile clubs of France, Austria and Switzerland have been entered into and the former has cordially opened its house to all members visiting Paris.

In Munich the number of automobiles licensed by the police authorities is 25, and this being the maximum allowed in the city under present regulations further official action will have to be taken before the number can be increased. The good Bavarians are so cautious in such matters that the Vienna *Fremdenblatt* suggests that for the protection of pedestrians a policeman be assigned to each person in the function of nursery maid!

Count Stefan Gyulai made a most interesting journey last September from Vienna to Venice and back. His vehicle was an eight-horse-power Daimler. From Vienna he journeyed through Lower Austria, Steiermark, Krain, Kaernten, Goerz-Gradiska to Venice and back by way of Upper Italy and the Southern Tyrol. The distance covered was 1,630 kilometres, the journey from Vienna to Mestre, opposite Venice, being 696 kilometres. This part of the journey was covered in 29 hours, an average of 24 kilometres an hour. The 179 kilometres from Goerz to Mestre occupied 6½ hours; an average of 25 kilometres an hour. From Bruck to Graz 53½ kilometres were covered in 1 hour and 47 minutes, an average of 29 kilometres an hour. From Graz to Marburg 66½ kilometres were made in 2 hours and 30 minutes, an average of 26 kilometres an hour. From Cilli to Laibach, 47½ kilometres, in 2 hours and 45 minutes, the average was 27 kilometres an hour. From Mestre to Bozen was 267 kilometres, from Bozen to Toblach 104½, Toblach to Klagenfurt 195, Klagenfurt to Semmering 217, Semmering to Vienna 89, an average for the whole of 22 kilometres an hour. The distance from Toblach to Vienna, 501 kilometres, was made in 23 hours. Imagine, if you can, a horse making such a distance at an average of nearly 14 miles an hour! The Count, who was accompanied by the director of his estates, Herr von Lukacsy of Arad, guided his carriage all the way himself. They were attended by one servant. They met with no accident or interruption beyond a slight delay caused by a hot bearing between Padua and Vincenza, due to insufficient oiling. No difficulty was encountered in surmounting the Semmering pass, 950 metres above sea-level, and the still higher Berhauer Sattel, 1,250 metres in altitude. The roads were good for most of the way, and were exceptionally adapted to the automobile in the Tyrol and Steiermark. The carriage was covered, sheltering the occupants well. The weather, however, was favorable most of the time.

The very mountainous Austrian province of Steiermark, which

Count Gyulai and Herr von Lukacsy Touring from Vienna to Venice

The trip extended over nearly 1,000 miles and lasted a fortnight.

is favored with excellent roads, is to have the benefit of an automobile service connecting various important parts of the province, from East Steiermark to Hungary, with the city of Radlersburg. A company has been organized for the purpose under the official designation of *Erste steiermärksche Automobil-Verkehrs-Gesellschaft in Radlersburg*—the First Automobile Transportation Company of Steiermark in Radlersburg. The following motor-stage lines have been decided upon: Radlersburg, Purkla, and Gleichenberg to Feldbach and return; Radlersburg, Kaltenbrunn, St. Georgen, to Jennersdorf (Hungarian route) and return; Radlersburg, Muraszombad, Bellatinz to Alsolentva (Hungarian route) and return; Radlersburg to Luttenberg and back. The service will begin on May 1, 1900, with a ten horse-power omnibus on each route. The vehicles are to have a gauge of 1.16 metre, and will seat from eight to ten persons with standing-room for two others. Benzine motors with water-cooling will be used. The concession was given by the authorities with a promptness that shows a most favorable disposition towards the undertaking.

The interest in the coming first international contest for the Gordon Bennett cup is growing intense, and our French *chauffeurs* intend to strain every nerve to secure the trophy for France. Various racing-machines are building expressly for the occasion.

It is estimated that one thousand new automobiles will be marketed in Austria this year. Indeed the automobile, unlike other things, seems to be enjoying a far greater boom in Austria than in Germany.

Among all fashionable Automobile Clubs that have sprung up like mushrooms abroad, the most energetic seems to be that of Austria and Hungary, in Vienna, of which Count Pötting-Persing is the president. The members of this club have expressed their intention to take part in the following automobile events, to be conducted under the auspices of their own club and that of Baden Baden. In the first week of May a motor cycle race up the incline of the Exelberg, near Vienna. On May 13 an automobile race to the Kahlenberger Berg. On May 20 a trial for the two kilometre record along the main avenue of the Prater in Vienna. The last day of the month and the opening week of June have been set aside for an elaborate automobile race from Munich to Salzburg and thence to Vienna, open to all comers, with arrangements for public exhibitions of the contesting vehicles at all three of these cities. After the close of the projected Automobile Exhibition in Vienna will be held another record run from Vienna to Graz and thence to Baden-Baden. This will be followed by a series of races in

Baden-Baden, from the end of June to the end of July, on the dates when the famous horse races of that popular watering place were wont to be held. Between the first week of August and the middle of that month another long-distance run will be made through the picturesque region of Saltzkammergut, covering the following points: Ischl-Strobl, Gilgen-Scharfling-See-Unterach-Weissenbach-Ischler Brücke. The most interesting point along this route, I dare say, will be found to be the

Count Pötting-Persing, President of Austrian Automobile Club

steep incline of the Scharflinger Berg. After these events the racing members of the club will betake themselves to France to try for new laurels there.

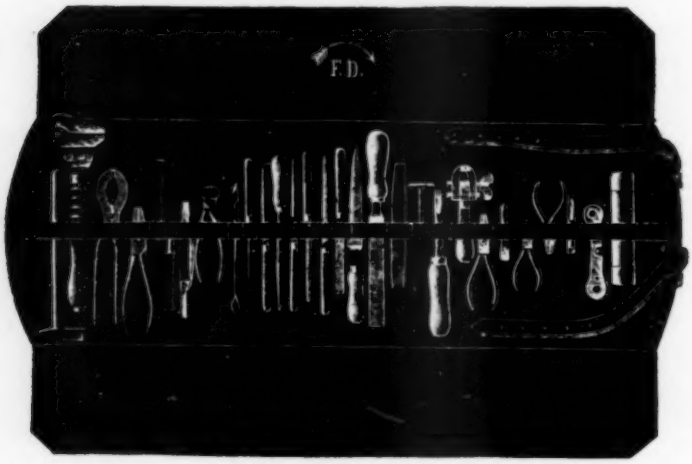
In the spring a motor-omnibus line is to be established for one of the most beautiful sections of the Thuringian Forest, running over the perfect roads between Ilmenau-Rammersberg, Stützerbach, Friedrichsroda, Oberhof, Schmucke and Schwarzburg.

In Nice a novel automobile party recently took place, the occasion being the baptism of the infant son of M. Leon Desjoyaux

and the infant daughter of M. Noël Desjoyaux, both known as intrepid *chauffeurs*. They proceeded to the church in their automobiles, accompanied by various friends also in automobiles—among them the Prince Lubecki—forming a joyous procession. The ceremony over they returned to the residence of M. Noël Desjoyaux to honor the double baptism with appropriate festivities.

The Italian military authorities are taking an active interest in the possibilities of the automobile, and the ministry of war has directed inquiries to various foreign manufacturers as to what might be furnished, especially in the line of ambulances, field-post and munition wagons.

The sporting club of Baden, whose president is Prince Alexander Solms, has decided to establish an automobile section.



Automobile Tool Case

The Progress of Motor Vehicles

By W. N. Fitz-Gerald

Read before Twenty-seventh Annual Convention of the Carriage Builders

FOR several years past the carriage industry has been agitated over the advent of the motor vehicle to an extent that seems almost impossible of explanation, as its success means nothing more than the substitution of mechanical for horse power. In either event the carriage remains, and the carriage builders' vocation continues as in the past, while the effect upon buyers, if the new vehicle becomes a success, means increased interest in carriage riding and out-of-door exercise.

If science and skill succeed in producing a vehicle for pleasure or business that can take the place of the horse-drawn vehicles of to-day—one that will cost less to make and to keep; one that can be rendered equally available and has as great or greater elements of safety—then the automobile will become an important factor as an additional contribution to the needs of advanced civilization.

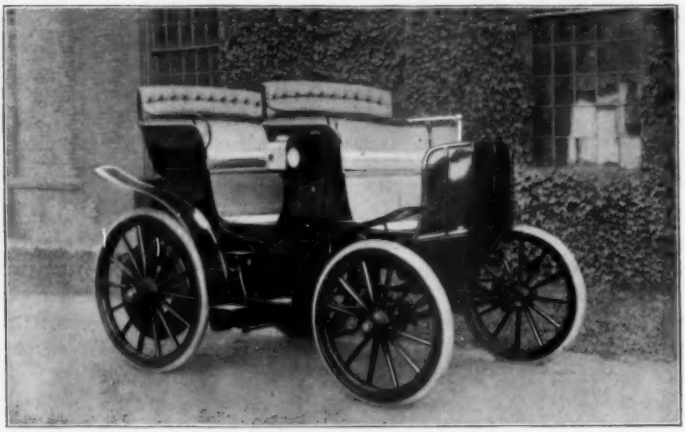
In New York City it is estimated that the number of horses in use is over 200,000. One-half of these are used for pleasure or light driving, and with three vehicles to every two horses, an estimate that is considered fair, we have 150,000 as the number of carriages in that city. On that basis, the total in our cities of 10,000 population and upward would be fully 1,500,000. There is, therefore, nothing in the advent of the motor vehicle to discourage the builders of high-priced carriages, while the builders of lower grades of work will not come in contact with it in any way.

Our people will either make it a success and encourage a large production, or the automobile will be a thing of the past in ten years. It is the duty of the carriage trade to give it every encouragement possible, consistent with safe business. Builders should bring their best skill to bear upon the carriage portion and be prepared to purchase reliable motors.

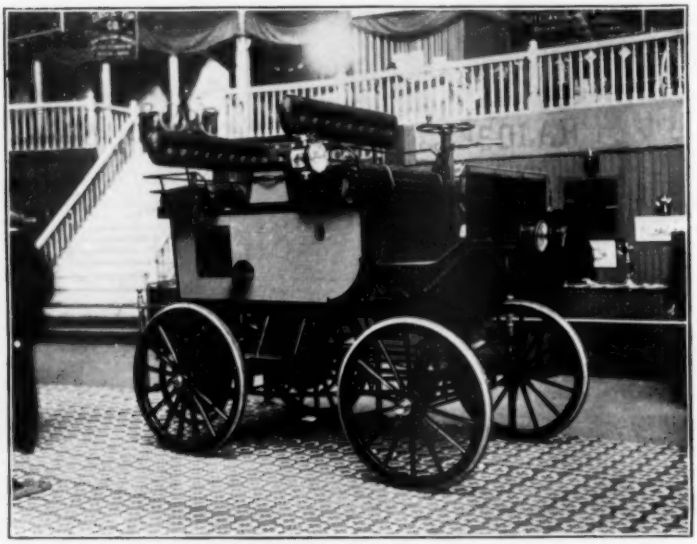
All carriage builders need not enter into the construction of the automobile, but none should antagonize it, for come it will, and antagonism will not check its progress.

Viewing the automobile industry from its favorable and unfavorable points, we can see nothing in it but good to the carriage industry, provided a conservative course is followed.

Gallery of Some Automobiles



Waverley Wagonette



Indiana Automobile Co. Brake

Shown at New York Exposition

Electric Stanhope

Vollmer Forecarriage Victoria

Automobile Tariffs

THE time is now come when the American automobile manufacturer, having established himself in his own country, looks about him for new worlds to conquer. No longer content with filling the wants of his own countrymen, he has cast his eye abroad, narrowly surveyed the unexplored field, and taken the necessary steps to secure a foothold in the new market. It is not the first time that the American manufacturer has thus peacefully invaded Europe. His locomotives are now running upon the railways of England, France and Russia; his machine tools are used in countless shops, from the Atlantic Ocean to the Ural Mountains, from the North Sea to the Mediterranean; his bicycles have supplanted the heavier and less graceful machines of his English and French rivals. His deep inroads in the various European countries have caused such consternation and alarm that the various European governments have been petitioned to check the invasion of the American upon their territory by the imposition of a restrictive tariff, which enabled the home industry at least to hold its own. The constantly increasing American export trade in automobiles has been regarded with little favor abroad. Some of the European governments have modified their old tariff laws, and rendered them more severe, in order to protect the automobile industry from the ravages of the encroacher. The reason for the protection of the native industry is to be found, not so much in the cheapness as in the better workmanship and more handsome appearance of the American automobile. In view of the gradually growing foreign trade of the United States in motor-carriages, we have deemed it advisable to indicate to the exporter exactly what obstacles must be overcome ere he can introduce his wares into foreign countries; what sums he must pay before Europe will open its portals to his automobiles. Undoubtedly the most important buyers in Europe are England, France and Germany; and to a discussion of their tariff laws the present article will therefore be confined.

England, ever true to her free trade traditions, welcomes the American automobile maker with open arms. No duties whatever are exacted from the importer of motor carriages. Automobiles are brought in and out without restrictions, whether they be of English or foreign make.

In France, on the other hand, an elaborate system of tariff regulations has been drawn up.

Automobiles are divided into two classes. In Class A are included motor carriages designed to carry persons. In Class B belong those vehicles used for carrying merchandise.

In both classes a general tariff and a minimum tariff is imposed. The general duty is applicable to wares made in those European and American countries from whom France has obtained no commercial concessions by treaty or otherwise. Certain portions of the United States are included under this head. The minimum duty is levied only upon goods imported from those countries with whom France has made commercial compacts for the common benefit of its own manufacturers and those of the countries in question. Those portions of the United State not included under the general tariff head receive this concession.

In Class A the duty is imposed on the carriage proper and on the driving mechanism. On carriages weighing 125 kilos. (275 lbs.) and more, the motor being included, a general duty of 60 francs per 100 kilos. or a minimum duty of 50 francs per 100 kilos. is imposed. For carriages weighing less than 125 kilos., motor included, a general duty of 150 francs and a minimum duty of 120 francs is collected. It follows, therefore, that a heavier tariff is levied upon the lighter than upon the heavier carriage, the French customs officials holding that, for an equal volume, the lighter carriage represents a greater value than the heavier vehicle.

In Class B a subdivision is made. A general duty of 30, 45, or 100 francs per 100 kilos., and a minimum duty of 20, 30, or 80 francs per 100 kilos. is levied upon electrically driven vehicles. On vehicles driven by petroleum, gas, air, etc., a general duty of 30 or 18 francs per 100 kilos. or a minimum duty of 20 or 12 francs per 100 kilos. is imposed.

A special tariff must be paid on imported electric accumulators, whether or not they be intended for automobile use. The general duty on a battery is 21 francs per 100 kilos., the minimum duty 16 francs, 50 centimes per 100 kilos. The importer of an electromobile is therefore compelled to pay two taxes, one on the carriage proper and driving mechanism (Class A), and another on the accumulators.

Motocycles, like ordinary bicycles, are taxed on their total weight (motor included). The general tariff is 250 francs per 100 kilos. and the minimum tariff 220 francs per 100 kilos.

Upon automobile parts imported into France, the same duty

is levied as upon the carriages themselves. When, however, the body and upholstered seat constitute 50 per cent., the body alone 40 per cent., and the wheels 28 per cent. of the total weight, the maximum tariff of 150 francs per 100 kilos. can be imposed; only, however, if the weights of the parts mentioned be respectively less than 62½ kilos., 50 kilos., and 35 kilos. When the wheels alone, tired or untired, are imported, the maximum tariff is imposed in all cases.

Besides the payment of a tax the importer must conform with certain requirements exacted by the Government. He must describe his vehicle in detail, state its weight, the country in which it was made and from which it was imported; give his name and address, and the distinctive marks of his vehicle, if there be any. Travelers temporarily residing in France, who import foreign motor carriages, must deposit the total amount of the tax levied upon their vehicles. This duty is returned when the traveler takes his automobile out of the country. In order to tour in other countries with his imported motor carriage the automobilist must obey certain formalities.

Germany, though she has ever jealously watched the development of American trade and endeavored in every way to protect her own industries, has been somewhat lax in restricting the importation of automobiles. The intention of the Electric Vehicle Company to establish a German branch house has raised a storm of protest among German manufacturers. For it is feared, and not without reason, that the keen competition of the American bicycle-maker may find a parallel in the wholesale importation of American motor-carriages. The German press has already taken up the cudgels in defence of the home industry and has vigorously advocated the erection of barriers which will effectually prevent the swarming-in of foreign automobiles.

In the existing German tariff schedule no special provision has been made for automobiles. Motor vehicles are therefore admitted as ordinary carriages upon the payment of the schedule duty of 150 marks for each vehicle. No restrictions are placed either upon size or weight.

On all imported articles the tariff rate is governed by the polish or outward finish of an article, in which respect the German system is unique. The distinction between rough and finished work often leads to curious decisions. Thus the rating of a fire-proof safe is changed, if, as in most American safes, one of the panels be decorated with a picture. The duty on carriages is increased when any portion of the vehicle is uphol-

stered. But since American manufacturers exercise sufficient care that their carriages be not unduly upholstered, the tariff usually remains at 150 marks per vehicle.

The German press has suggested the imposition of the usual machinery duty on automobiles—a duty based upon the material of which the machine is principally composed, modified, as already explained, by the polish, painting, finish, and outward decoration. These conditions, while theoretically simple, are in practice often exceedingly complex, so that it is frequently impossible, even for an expert German importer, to state precisely what will be the duty on a new article until a sample has been imported and subjected to actual classification and appraisal by the customs officials. An automobile is, however, essentially a vehicle, and the custom house will probably continue to impose the present imperial schedule rate until the tariff will have been modified in compliance with the demands of German manufacturers.

Thanks to the zeal, energy, knowledge, and thoroughness of our manufacturers, the American automobile industry has little to fear from European competition on our own soil. Although there be no need of a protective tariff, nevertheless foreign motor carriages are not admitted duty free. True it is that there is no special provision in the Dingley tariff schedule for automobiles, but under Section 193 " articles or wares not specially provided for * * * composed wholly or in part of iron, steel, lead, copper, nickel, pewter, zinc, gold, silver, platinum, aluminium, or other metal, and whether partly or wholly manufactured " are subjected to an *ad valorem* duty of 45 per cent. The Section is so broad in its scope that automobiles can readily be included. The Collectors of our ports accordingly levy a duty of 45 per cent. on all imported motor carriages, for the present.

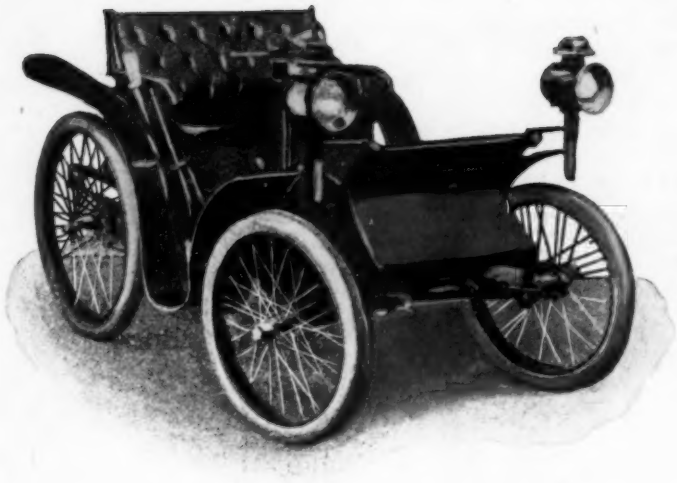
At a time when the commercial struggle of the nations is fiercer than ever, when each country is trying to secure the largest possible share of the world's trade, the various governments are perhaps justified in establishing protective tariffs. But the best protection, as we have seen in our bicycle and machine tool industries, consists, not in the imposition of restrictive taxes and the enforcement of stern tariff laws, but in the production of wares which, by reason of their excellent workmanship, coupled with their greater cheapness, so completely out-class similar products of European manufacture that foreign competition is not to be feared.

The "Wartburg" Motocycle

THAT the Parisian types of motocycles have had a certain effect upon similar German automobiles goes without saying. The Werner system, perhaps more than any other, has influenced German makers, largely because it seems best adapted to the motocycle, because it does not require any change in the construction of the wheel, increases the weight but slightly, and enables the rider to propel the machine either by means of the pedals or by means of the motor.

The Werner system has been applied in the "Wartburg" motocycle with noteworthy success. The motor is mounted in front of the steering-head, and thus all the merits of the front-driven, front-steered automobile are obtained, the motocycle is rendered usually stable and is excellently balanced. The motor has several changes of speed, develops about ¾ H. P. and makes 1,300 revolutions per minute. By means of a belt and pulley, which constitutes one of the most silent and efficient transmission gears, the power developed by the motor is used in driving the front wheel.

The carbureter is secured to the upper brace of the bicycle and is composed of two parts—the carbureter proper and the benzine tank, communicating with each other by means of an aperture in the bottom of the tank. The tank has a capacity of one gallon—a quantity of benzine which will enable the cycle to run 75 miles. The proportions of the mixture of gas and air are regulated by means of a lever on the handle-bar. Through the medium of this lever alone, the motor can be started and stopped, and the speed changed at will. The explosive mixture is electrically ignited by a spark-coil energized by a small accumulator battery. When the motor is in operation the pedals can be held stationary. If it be desired to stop the motor the electric current is cut off and the lever so turned that the exhaust valve is closed, with the result that no gas is drawn into the cylinder. In order to drive the cycle at its highest speed the lever previously mentioned is operated to open the air valve as far as possible, and the gas-valve is regulated in accordance with the noise of the exhaust. The lubricator is mounted in front of the motor and automatically supplies oil to the moving parts. With all its accessories the motocycle weighs but 66 pounds.



A Typical French Voiturette

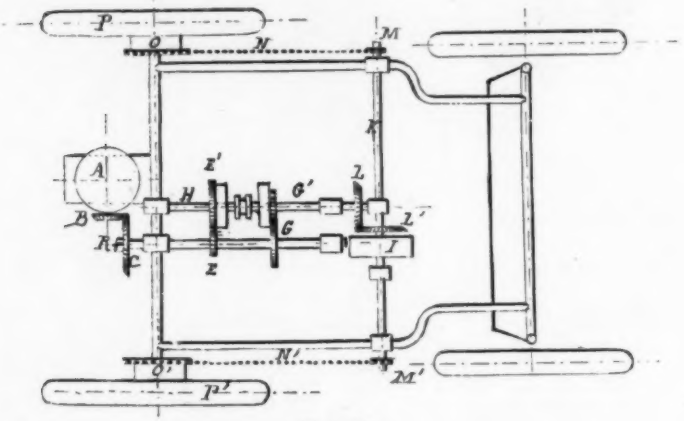
THE light, handsome carriage which forms the subject of the above illustration, is a type of *voiturette,* which has been successfully exhibited at the expositions of Paris, Berlin and Leipsic. As our perspective and plan views indicate, the vehicle is a small quadricycle, weighing about 450 pounds empty, and measuring 6 feet 7 inches in length and 4 feet 5 inches in maximum width; the distance between the wheels is 4 feet.

The front wheels are 25 inches in diameter, the rear wheels 29 inches. Each wheel is provided with steel tangent spokes and with a pneumatic tire 2½ inches in diameter. The vehicle is steered by means of a divided axle, controlled by a tiller. The frame is made of cold-drawn steel and is firmly braced to secure the strength so necessary in automobiles. The frame is supported on the wheels by springs, the empty spaces being filled in by panels which constitute the carriage body and provide accommodation for two persons.

The vehicle is driven by a 2¼ H. P. motor of the De Dion-Bouton type, mounted in the rear portion of the carriage at *A*. Cooling of the cylinder is effected by means of a water-jacket, which takes the place of the usual head. The water is contained

in a reservoir which has a capacity of 3.8 gallons and which is mounted above the motor. The thermo-siphon principle of circulation is used. The water evaporates at the rate of four to five pints per hour.

Power is transmitted to the rear wheels by two bevel-gears *B C*, controlling an intermediate shaft *D*, which drives another intermediate shaft *H*, by means of the gearing *E E'* or *G G'*. The shaft *H* is connected with the shaft *K*, carrying the differential gear *I*, by the bevel-gears *L L'*. At the ends of the shaft *K* are two sprocket-wheels connected by chains *N N'* with the sprocket-wheels *O O'* secured respectively to the wheels *P P'*.



Plan View

The group of gears *E E'* and *G G'* provide two changes of speed. The gear-wheels *E'* and *G'* are loosely mounted on the shaft *H*, but can be thrown into gear by a clutch. By means of a lever controlling a sleeve sliding on the shaft *H*, either of the two speeds can be obtained. The special form of clutch used enables the *chauffeur* to pass from one speed to the other, silently and without any unnecessary shock.

The intermediate or higher speeds can be obtained by varying the proportions of the explosive mixture and by properly controlling the ignition. The motor is started by means of a crank connected with *R*, at the end of the shaft *D*. The highest speed which can be attained is 17 miles per hour. Grades can be ascended with the smallest speed-gear at a rate equal to one-half the maximum speed.

The Draulette Electromobile

BETWEEN the motor and the driving-wheels of most electromobiles an intermediate shaft is located which carries the differential. If this intermediate shaft could be dispensed with, the transmission gear would gain not only in simplicity but also in mechanical efficiency. Automobile-makers have, therefore, either connected the differential directly with the motor, or they have suppressed it altogether by employing

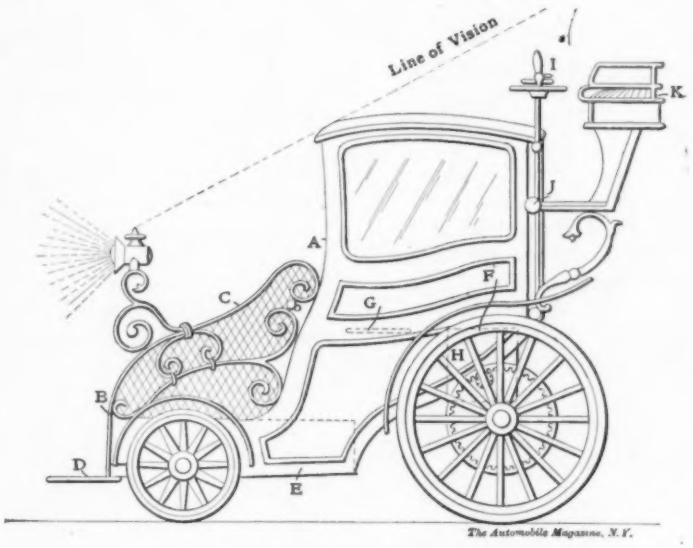


Fig. 1. Side Elevation of the Draulette Cab

two electric motors, one geared with each wheel. In the first method, a two-piece axle is employed which considerably impairs the strength and rigidity of the frame. Moreover, larger parts are required in the differential, since the gears must of necessity turn more slowly. The arrangement has been abandoned owing to its many disadvantages. The second construction is now in general use on electromobiles, but lacks simplicity and is both costly and heavy.

An improved arrangement of the driving mechanism has recently been patented by M. Draulette, in which the inconven-

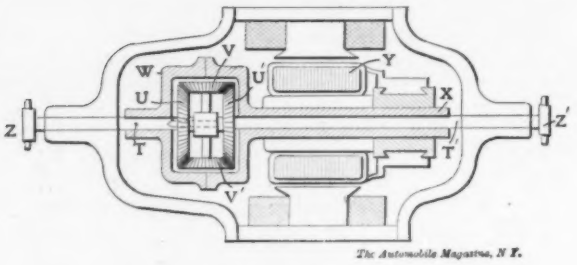


Fig. 4. Section through Differential and Motor

iences of the first method and the complexity of the second have been very ingeniously overcome.

The improvement in question is sectionally shown in Fig. 4, in which T and T' are the two shafts of the differential upon which the bevel-gears U and U' are secured, meshing with the bevel-gears V and V', loosely mounted within the differential casing W, formed with an extension X, constituting a bearing for the shaft T'. Upon the bearing, the armature Y and the collector of an electric motor are secured. If it be so desired two collectors can be used, one on the right and another on the left, each connected with the armature. The arrangement is evidently applicable to all kinds of electric motors whatever may be the character of the current by which they are driven. The armature instead

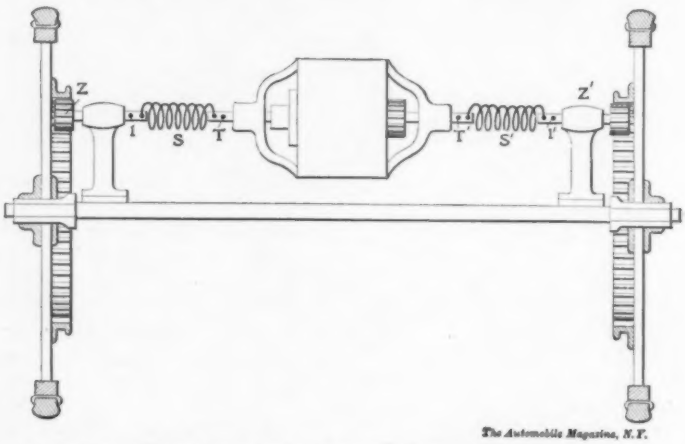


Fig. 5. Flexible Connection between Motor-shaft and Wheels

of being secured on the bearing X, can be mounted directly on the casing W of the differential.

The advantages of this improved construction over the methods already mentioned are its inexpensiveness, lightness, simplicity, and efficiency.

The driving-wheels can be directly actuated by pinions Z and Z' on the ends of the shaft T and T' of the motor (Fig. 4),

Fig. 2. The Draulette Cab in Perspective

or by means of pinions Z and Z' (Fig. 5) on the ends of the shafts L L', connected by flexible joints S and S' with the shafts T and T', or by a chain gear. In the second method (Fig. 5), in which the pinions Z and Z' are secured on the shafts L L', mounted in supports bolted to the rear axle, the shocks due to obstructions and inequalities in the road are not trasmitted to the motor.

In order to facilitate the starting of the carriage and to avoid variations in the speed of the motor as well as strains on the transmission gear, the shaft carrying the bevel gears V and V' is connected with the casing W of the differential, not rigidly as in the usual construction, but elastically by means of springs R coiled around supports A A' secured to the casing W.

In most electromobiles, when the carriage is stopped by means of the brake-pedal, the current is cut off from the motor; but the switch remains in starting position and must be returned to zero by hand. If the driver forget to set the switch back, the carriage, when the circuit is completed, will start off at the speed which it had before cutting off the current, with results that are often disastrous to the motor. In the Draulette carriage the circuit-breaker is entirely discarded, and the mechanical brake-pedal and

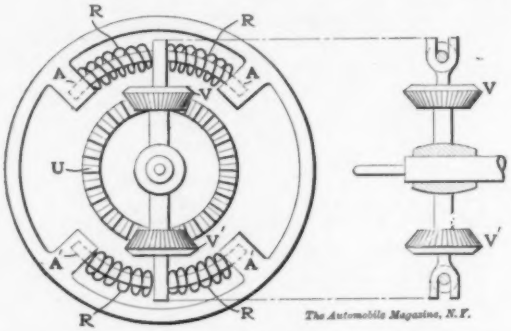


Fig. 6. Elastic Connection between the Differential Gearing and Its Casing

switch so connected that when the brakes are applied the switch is automatically returned to zero and the electric brakes operated. If it be so desired the electrical brakes can be actuated independently.

In Fig. 7, 1 is the switch-cylinder, turning with the shaft 2. The switch is operated by a wheel or hand lever. The pedal 3 is loosely mounted on the shaft 2 and actuates the mechanical brake by means of the link 5. The switch carries a lug 4 which raises the pedal 3 when, in order to increase the speed of the carriage, the cylinder is turned in the direction of the arrow. If pressure be applied to the pedal, the switch is turned in the opposite direction, set back to zero, and then moved in a position to operate the electrical brakes. It is evident that, when the switch is independently turned to apply the electrical brakes, the pedal remains stationary.

The Draulette Electromobile

Current is derived from an accumulator battery *E* (Fig. 1) inclosed in a special casing which can be slid in and out of the carriage through the front *A*, or lifted out by raising the removable platform *B*. The low position of the battery contributes much to the stability of the vehicle.

The steering-gear (Fig. 3) is of the irreversible type and is mounted upon a divided axle. The forward axle carries two lugs *L* and *M*, serving as bearings for a screw-shaft *N*, turned by a sprocket *o* and chain *p*. A nut *Q* is carried by the screw shaft

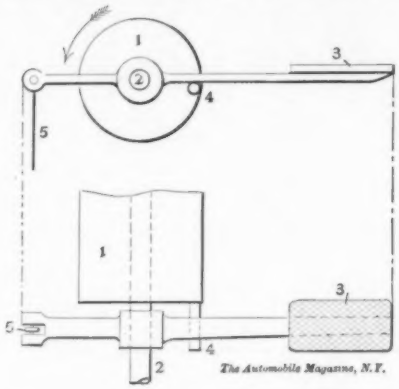


Fig. 7. The Brake-Pedal and the Switch

and is connected with a link *R* and pivoted at *Q'* to one of two levers connected by a rod *S S'*. By turning the screw-shaft, the nut in moving will cause the levers to swing the steering-wheels in the desired direction.

From Figs. 1 and 2 it will be observed that passengers enter not from the side but from the front *A*, by means of the step *D* and the platform *B*, flanked by side members *C*. The Draulette cab differs from other electromobiles, not only in the nature of the driving mechanism, but also in general appearance. The construction possesses advantages too obvious to be dwelt upon.

AN AUTOMOBILE BRONCHO

In Texas a wealthy stockman will use an automobile for making inspection trips around the wire fence of his ranch. The country being level and free from brush and other obstructions, it is thought that the automobile will prove practical.

Lucas-Villain Explosion Engines

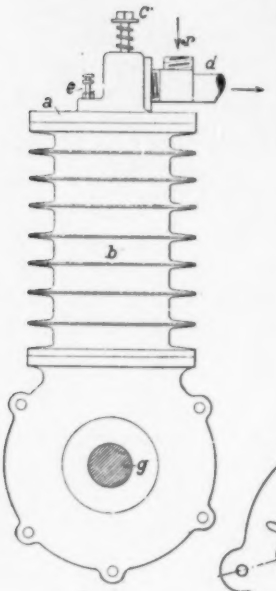


Fig. 1.

THE illustrations presented herewith represent a new type of explosion engine devised by Lucas and Villain.

The arrangement of valves and igniter directly on the cylinder-head necessitates but a single joint in the cylinder. The admission-valve *c* opens on the intake stroke of the piston and is reseated by means of the spring *c'*. The exhaust-valve is operated by a pinion *f*, secured to the motor-shaft *g* and engaged by a gear *h*, the sizes of pinion and gear being in the ratio of 1 to 5. The gear is provided with a cam *i*, with the peripheral

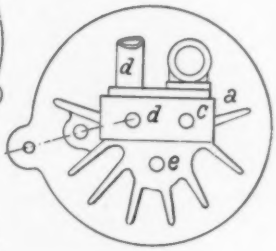


Fig. 2.

surface of which a friction-roller *j* is always in contact. The roller is mounted in a cap *k* on a rod *l*, operatively connected with a lever *m* fulcrumed on a support *n*, to actuate the exhaust-valve stem. The exhaust-valve, like the admission-valve, is reseated by means of a coiled spring *o;* and a similar spring forces the roller *j* constantly into engagement with the cam *i*.

The explosive mixture of air and gas is led from the carbureter by means of the pipe *r*. The piston is provided with the usual rod *t*, connected by a crank *u*, with the shaft *g*.

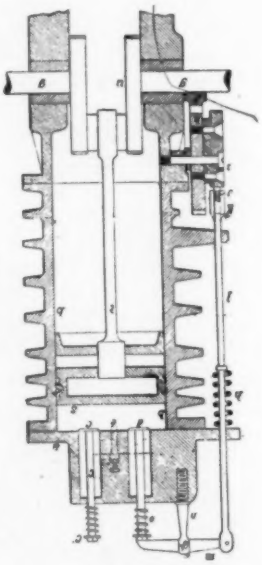
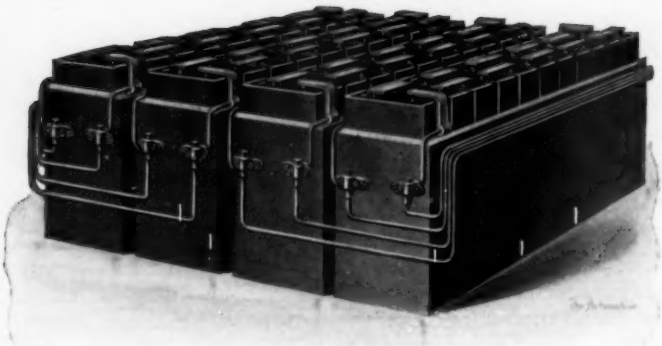


Fig. 3.



Accumulators

By Prof. Félicien Michotte

LET us take two plates of lead and plunge them into water containing sulphuric acid; then let us connect one of them with the positive pole and the other with the negative pole of a source of electricity; and, finally, let us set the latter in operation. A current will be established through the liquid and the plates, and, under the influence thereof, there will be produced in the interior of the liquid a series of chemical phenomena, the result of which will be a chemical transformation of the lead of the plates; and such transformation will have absorbed the current sent into the latter.

If we suppress the source of electricity and connect the two plates, there will be produced in the wire that unites them an electric current that may be collected; and during such disengagement the plates will resume the chemical state that they possessed before receiving the action of the electric source.

The tangible result is therefore this: An electric current has been sent into the plates and has, as it were, *accumulated* therein, and, at a given moment, has disengaged itself therefrom. It is for this reason that such an apparatus is called an "accumulator."

Practical Accumulator.—In practice, things take place less simply. In order that an accumulator may operate, the lead must be oxidized and converted into a state of oxide, in order that there may be had what is called the formation of "active material."

The plates are therefore previously oxidized by an operation that constitutes the " formation " of the accumulator.

On another hand, the quantity of electricity accumulated in the two plates is feeble, and depends upon the quantity of active material that the accumulator contains. Now, since this material must be of relatively feeble thickness and be arranged as a superficies of the " working surface," we are obliged, in order to obtain a certain quantity of electricity, to employ plates of a number that varies according to the mode of construction of the accumulator and to what is required of it.

The assembling of several plates in the same box constitutes what is called an " element," and the quantity of electricity accumulated therein is called the " capacity " of the element. In order to compare accumulators with each other, we generally refer to them by weight, and speak of an accumulator of 6, 8, 10 or 12 kilogrammes, that is to say, of an accumulator that contains 6, 8, 10 or 12 kilogrammes of plates.

Boxes.—The boxes that contain the elements are made of ebonite or celluloid. Those made of the last-named material are the lighter and cheaper, but should not be used in automobilism, on account of their easy combustibility.

Voltage.—When an electric current is sent into an accumulator (an operation which has received the name of " charging "), it is found from the voltage that the electro-motive force of the apparatus gradually rises; but that, starting from the moment at which 2.4 or 2.45 volts are obtained, such force no longer increases. We say at this moment that the accumulator is *charged,* since, whatever be the current that is sent into it, the electro-motive force will not increase.

The maximum electro-motive force of an accumulator is therefore 2.45 volts; and whenever it is desired to obtain a greater voltage, several accumulators will have to be combined with one another.

Battery.—When several accumulators are combined, they constitute what is called a " battery." Each battery consists of a number of elements proportional to the voltage that it is desired to obtain—each element being reckoned at 2 volts. A battery to give 80 volts will require 40 elements; but, in practice, 2, or even 4, more are added, making 42 or 44 in all.

The weight of each element is proportional to the *quantity* of electricity that it is desired to obtain—such quantity being measured in ampere-hours.

We say that a battery gives 20 ampere-hours, and, if we wish to specify it more completely, we say that a battery of 6 kilo-

grammes gives 20 ampere-hours, this meaning that a battery having elements each containing 6 kilogrammes of plates, will, in discharging itself, give a quantity of electricity measured by 20 ampere-hours.

Tension: Quantity.—As well known, electric batteries are united in quantity or in tension according as it is desired to have a quantity of electricity or a sufficient electro-motive force. The same thing is done with accumulators.

The quantity that each element is capable of giving is increased by increasing its number of plates, or else by uniting several elements in quantity, that is to say, by uniting all the negative plates on the one hand and all the positive ones on the other. Then, in order to obtain electro-motive force, the elements are united in tension, that is to say, the positive pole of each of them is united with the negative pole of the following.

Rate of Charging.—When we are charging an accumulator we should not send into it any quantity of electricity whatsoever, but should limit the quantity, without which we might destroy the accumulator. The charging is generally done with a current of one ampere per kilogramme of plate. This is called the normal rate of charging. An accumulator of 6 kilogrammes will be charged by a current giving 6 amperes. The number of amperes per kilogramme of plates is the " rate of charging " of an accumulator.

Rate of Discharging.—Inversely, at the time of the discharging, the current produced should not exceed a normal rate of discharge, that is to say, we must give the accumulator only a limited number of amperes per kilogramme of plates, or else we shall destroy it. This rate generally varies between 1 and 1.5 ampere, for pasted oxide accumulators.

It must be remarked that, at the discharge, an accumulator does not render up all the electricity that it has received. When any element whatever is discharged, the voltage that was 2.4 at the beginning falls to 2.05 volts, remains at that figure for quite a long time, and then falls to 1.9 volt, and finally to 1.8. At this moment, the discharge must be arrested, since otherwise the accumulator would empty itself entirely and be destroyed. It is even prudent to stop at 1.9 volt.

1st Remark.—An accumulator allows its current to flow pretty nearly at the rate that is required of it, acting in the same way as would a reservoir of water provided with a cock, which would discharge a greater quantity of water in proportion as it was wider open; with the difference, however, that as the current is produced in measure as it is used, the accumulator will be destroyed

if too large an amount be required of it. A certain rate of discharge per kilogramme must, therefore, not be exceeded. Such discharge depends upon the accumulator and its interior construction, and generally varies in practice from 1 to 1.5 ampere in oxide accumulators, and from 1 to 3 amperes per kilogramme in lead accumulators.

2d Remark.—In consequence of the production of the current by chemical phenomena, it follows that an accumulator renders so much more electricity in proportion as its discharge takes place more slowly. Consequently, the quantity of electricity rendered by an accumulator, that is to say, the *capacity* of the latter, varies with the rate of its discharge. The more slowly it is discharged, the more electricity it will produce. Thus, an accumulator of 12 kilogrammes will give 120 ampere-hours of capacity in discharging itself in one hour, and this will give a rate of 10 amperes per kilogramme; while in two hours, corresponding to a rate of 5 amperes, it will give a capacity of 125 ampere-hours. This accumulator will give in

1 hour,	at	the	rate	of	10	amperes	capacity,	115	ampere	hours.
2 hours,	"	"	"	"	5	"	"	125	"	"
3	"	"	"	"	4	"	"	135	"	"
4	"	"	"	"	3	"	"	145	"	"
5	"	"	"	"	2.5	"	"	155	"	"

An account should therefore be taken of the rate of discharge, and, consequently, of the time that it has taken an accumulator to discharge itself, in order to estimate it. We ought to say that such an accumulator of 10 kilogrammes has a capacity of 145 ampere-hours at a rate of discharge of 3 amperes.

Measurement of Capacity.—The capacity of an element is estimated in ampere-hours, and the capacity of a battery, (1) in ampere-hours; (2) in watt-hours; and (3) in horse-hours.

1. In Amperes.—We say that a battery has a capacity of 135 ampere-hours (the word " hours " is often understood) at a rate of discharge of 25 or 30 amperes. If nothing is said about the rate, the normal one is understood. The normal capacity of the " Planté " is from 11 to 12 amperes to the kilogramme.

2. In Watt-hours.—As watts are the product of amperes by volts, the above-named battery would give:

135 amperes x 80 volts = 10,800 watts.

The capacity of the Planté accumulator is, per net weight of plates, from 16 to 24 watt-hours to the kilogramme. Per gross weight of the battery (that is to say, boxes and liquid included), it is from 11 to 16 watt-hours.

3. In Horse-hours.—The capacity of a battery is expressed also in horse-hours. This is easily done, since watts are the product of amperes by volts, and a horse is represented by 736 watts.

It suffices to multiply amperes by volts and divide the product by 736. A battery of 135 amperes and 80 volts will give:

$$\frac{135 \times 80}{736} = 14.67 \text{ horse-hours.}$$

As the amperes are ampere-hours, the product represents horse-hours, that is to say, the work produced by 14 horses during one hour, or by one horse during 14 hours.

Remarks.—(1) As the capacity varies with the output, the number of horse-hours varies in the same way. (2) A horse-hour is produced by a Planté with a weight of plates of from 30 to 40 kilogrammes, according to the rate of discharge, and per gross weight of battery (with box and liquid) of from 45 to 65 kilogrammes. (3) We often hear a person say: "My accumulator makes 100, 120, or 150 kilometres." This is a false expression that seems to say something and means nothing. It simply proves that those who use it know nothing themselves about accumulators, or else are endeavoring to deceive the public. In fact, the capacity necessary for making a determinate trip depends upon two essential things: the capacity of the accumulator, which is tantamount to its weight, and to the load that the motor which it actuates is to pull. An accumulator that will permit a carriage seating two or three persons to cover 60 kilometres, will be incapable of propelling an 8-passenger omnibus for 6 kilometres, while it will allow a tricycle to make a trip of 100 kilometres. The motor employed, its rendering, and the load drawn or propelled (factors often lost sight of) must also be taken into account.

Rapidly Charged or Discharged Accumulators.—The time required for charging or discharging an accumulator without injury thereto has caused manufacturers to employ the term "rapidly charged accumulator"—a denomination that has merely a relative signification and indicates nothing precise; for such or such an accumulator may be a rapidly charged one if it be compared with some type that is more slowly charged.

Rendering.—An accumulator receives a certain quantity of electricity at a charge, and, in emptying itself, renders a less amount of it. The ratio of these two quantities is the "rendering." An accumulator at a normal rate of discharge renders 80 per cent. of what it has received. Its rendering diminishes with the rapidity of its discharge.

Short-Circuit.—If two accumulator plates are in contact, there is produced what is called a " short-circuit," and the accumulator loses its electricity. It discharges itself upon itself and produces no current, and at the end of a certain length of time, it can no longer even be charged.

Dead Accumulators.—After a short-circuit has acted for a certain length of time, and the accumulator cannot be recharged, it is said that the latter is " dead."

Sulphatation.—If a battery remains for a long time out of service or has been too thoroughly discharged, the active material of the negative plates is converted into sulphate, and it is said that " sulphatation " has occurred. The accumulator is then out of service and cannot operate again until after its plates have been desulphated.

Systems of Accumulators.

The systems of accumulators present a great variety as regards form and details of construction, but may all be referred to two different types—the pasted oxide and the lead.

Oxide Accumulators.—These apparatus, called also " pastille " accumulators, owe their name to their plates, which, instead of being " formed " with oxidized lead, consist of sheets of lead into which are punched holes for the reception of the active material, which is formed of oxides of lead.

Lead Accumulators.—When the plates consist of pure lead, the apparatus is called a lead or a Planté accumulator, or simply a Planté, after the name of its inventor.

Accumulators to be Employed.—The only accumulators to be employed in automobilism are those of the Planté kind, since this type of apparatus is the only one that really has a long life and that permits at the same time of a rapid discharge without becoming deteriorated. The pasted oxide accumulator has the drawback of being short lived. The oxides, whatever be their mode of fixation, swell up or become detached (if the current required be at a low rate of discharge), and falling, produce short-circuits. The result is that not only does the accumulator lose its capacity and discharge itself upon itself, but is very rapidly put out of service. Such destruction, moreover, is hastened by the incessant vibrations of the carriage; and there is not an oxide accumulator that can withstand these.

The lead accumulator has the advantage of being capable of being charged and discharged much more rapidly than the oxide accumulator, without being impaired.

Accumulators

An oxide accumulator charged at one ampere per kilogramme of plates will require for elements of 12 kilogrammes, with a capacity of 135 amperes,

$$\frac{135}{12} = 11 \text{ hours},$$

while a lead accumulator will require:

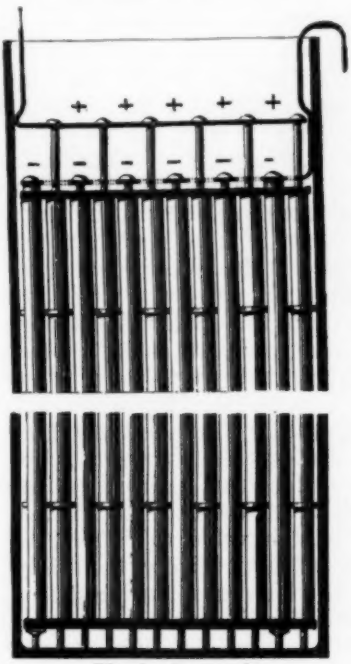
12 kilogrammes x 3 amperes = 36 amperes.

$$\frac{135}{36} = 4 \text{ hours},$$

and this rate of discharge of 3 amperes may be increased.

At its discharge, an oxide accumulator supports 2 amperes with difficulty, while with a lead one the discharge may reach 5 amperes without any inconvenience.

The lead accumulator has another advantage and that is that its capacity increases with its use, since it is "formed" a little more day by day. The contrary is the case in the oxide accumulator, the capacity of which is maximum at the beginning, but has a tendency to diminish with use. Certain parts of the carriage frame, entering into action, disturb its operation, and some of the active material becomes detached.



Phenix Accumulator

So, a test of a lead accumulator cannot be profitably made until after it has been in service for quite a long time, say for six months.

A test of an accumulator designed for automobilism can be made only upon a carriage, since, in a laboratory, although it is possible to reproduce the vibrations approximately, it is impossible, whatever be the precautions taken, to bring about the fits and starts in the discharge that occur during its operation upon a carriage.

An Automobile for Land and Water

An invention which will enable a horseless carriage to travel with equal ease and facility on water as on land is the interesting creation that will be the next step forward in the perfecting of the automobile conveyance now sweeping so swiftly into popular favor. The perfection of locomotion will have been reached when this system of automobilism is in use, for the driver of the horseless carriage can send his conveyance speeding over the country or leave terra firma and take himself and his party for a trip on lake or river without the need of any one alighting, and with the same propelling power in use for both land and water.

Two long and hollow metallic cylinders placed parallel to each other give the buoyant properties to the floating vehicle. These cylinders are made of aluminum, as being the lightest metal. Their size depends upon the weight of the party and of the automobile. The heavier the freight the larger the displacement. The driver of the automobile sits in the front of the cylindrical float, on the same seat that is his perch while driving on a roadway. When he has driven the horseless carriage on to the float he fastens the now useless wheels to the deck by means of suitable clutches and throwing the machinery out of gear with the wheels of the carriage he attaches it to the gear of the float. This change consists simply of throwing off a chain from a sprocket wheel that transmits the power to the wheels of the horseless carriage and attaching it to another sprocket wheel that causes the propeller shaft between the two cylinders to revolve at any desired speed. When seated on the front of the horseless carriage in his usual place, after the wheels have been fastened into position on the deck, the driver, or, as he should now be called, the pilot, has close to his hand two upright handles, one to start and stop the machinery, the other to manipulate the rudder, the chain of which runs between the cylinders to the rear of the float. The rudder is manipulated by connection with the steering gear of the automobile. The starting and stopping is done in precisely the same way and with the same machinery as when the automobile is ashore. The only difference is that the machinery in this case moves a propeller instead of four wheels.

Mechanical Propulsion and Traction

By Prof. G. Forestier

Fourth Paper

Previous to 1895 automobilism occupied the attention of a very small number of informed and intelligent experts. After the triumph of Levassor everyone wanted to become a driver. The gasoline carriage, in fact, satisfied the demand that existed for a light and rapid private vehicle.

At present the carriage provided with an electric motor seems destined, from this point of view, to supplant the gasoline carriage in the favor of those interested; but, incapable for the moment of moving beyond a relatively narrow radius around electric works, it must abandon to its rival the privilege of making lengthy excursions.

IV.—Resistances to be Overcome.—Since the very conditions under which the motive power must act in order to set a vehicle in motion involves a bad utilization of it, the first thing to be done is evidently to endeavor to reduce to a minimum the resistances to be overcome. To this effect, it is necessary to begin by well determining not only their nature, but also their value, so as to see whether it is possible to diminish the latter.

We shall therefore briefly recall the fact that the total resistant work results from the following factors: (1) The sliding friction of the journals in their boxes; (2) the force of translation upon the road; (3) the loss of live force resulting from the jarring of the different parts of the vehicle, produced by the roadway or by the motions of the motor, and transmitted to the ground or air; and (4) the pressure of the air.

The two first factors are proportional to the weight of the vehicle, and their numerical coefficients are sensibly constant within the limits of speed of the carriages considered.

The third is a function of the speed, of the flexibility of the springs, and of the elasticity of certain accessories, such as the dash-board, steps, lamps, etc.

The fourth is proportional to the square of the speed,* and to the surface of the projection of all the parts of the carriage upon

* This is conformable to usage. Nevertheless, it seems that for some time past certain railroad engineers have been inclined to adopt formulas in which the pressure of the air is simply proportional to the velocity beyond a certain value of the latter.

a plane at right angles with the direction of the motion; but its numerical coefficient varies with the form and the more or less partial overlap of the various parts of the vehicle.

This much said, we shall proceed to point out in succession how it is possible to express the values of the four above-mentioned factors for an automobile carriage.

1.—*Sliding Friction of the Journals in the Axle-boxes.*—This is given by the formula—

$$Tf = \varphi \frac{F}{D} p$$

in which F is the mean diameter of the journal; D the external diameter of the wheel; p the load supported by the journal in tons; and φ a coefficient expressed in pounds, and variable with the method of lubricating the journal, and with the nature of the rubbing surfaces.

2.—*The Force of Translation.*—If this consisted of the rolling friction alone it would be given by the classic formula—

$$Tr = (f \pm i) \frac{P}{D} \quad \dagger$$

in which P is the total weight of the vehicle in tons; i the declivity expressed in thousandths; f a coefficient expressed in pounds, and variable with the nature of the road and the width of the wheels.

This factor is more complicated. It comprises, in addition:

(a) The stress to be exerted in order to surmount the asperities of the road, and which has for value:

$$P\sqrt{\frac{h}{D}}$$

in which h is the height of the asperity. The work per corresponding foot will therefore be:

$$Tr' = \frac{n P}{l}\sqrt{\frac{h}{D}}$$

in which n is the number of the asperities of a height h that the road presents upon a length l.

(b) The stress due to depressions:

The surface of the road is not regular, but presents a series of concave and convex undulations. Dupuit has demonstrated

† Experimenters are not in accord as regards the influence of the radius of the wheel upon the tangential stress that opposes itself to the rolling thereof. According to Dupuit, such stress is inversely proportional to the square foot of the radius. On the contrary, Morin claims that it is inversely proportional to the radius. Others, like Baron Mauri, think that, independent of the radius for a certain degree of polish of the surfaces in contact, the stress is conformable to a certain relative size of the asperities.

that the drawing, v', of a two-wheeled cart over the concave parts, and v'' over the convex parts, are given, respectively, by the relations:

$$v' = v\sqrt{\frac{1}{1-\frac{R}{R_1}}}, \qquad v'' = v\sqrt{\frac{1}{1+\frac{R}{R_1}}}$$

where v represents the traction over a level upon the same even road; R the radius of the wheel; and R_1 the radius of curvature of the undulation.

For an automobile carriage, three cases must be considered: (1) The driving and steering wheels are placed upon undulations of the same nature—concave or convex; (2) the driving wheels rise upon a convexity, while the steering ones descend into a concavity; (3) the driving wheels descend into a concavity, while the steering ones rise upon a convexity.

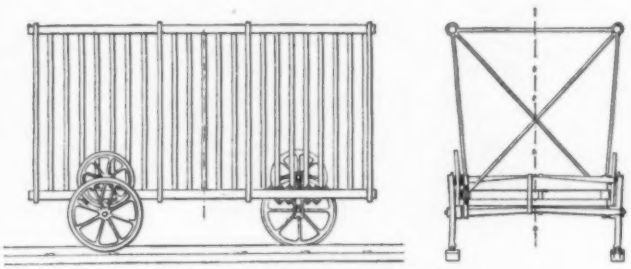


Fig. 16. The Gerstner Arrangement

In the first case, the relations v' and v'' are applicable to the whole. In the second and third cases, since the load is not the same upon the driving and steering wheels, it will be necessary, in order to have the total draught that results from the depressions, to multiply v' and v'' by a coefficient proportional to the load before taking the difference of them.

(*c*) The stress that results from the alteration produced in the form of the subsoil and roadbed by the load of the wheels.

Since the time of Coriolis (1832), the following formula has been admitted:

$$Tr'' = \tfrac{3}{5}\sqrt[3]{\frac{12}{mb}\frac{P^4}{D^2}},$$

in which m is a numerical coefficient variable with the compactness of the roadbed, and b is the width of the tires.

(*d*) The stress that results from curves.

In the traffic upon ordinary roads, as well as upon rails, the vehicle experiences an increase of resistance in sinuous passages.

In default of methodical experiments, it is impossible to give even an approximate value of the resistant work due to a curved motion as a function of the radius. All that we can say is that in some experiments made upon the total resistance with a Desdonit's dynamometric pendulum, it was found that there was a sudden increase as soon as the steering wheel was acted upon in order to change the line of travel.

Moreover, when the speed exceeds a certain limit, centrifugal force intervenes in an appreciable manner. The change of place laterally that it tends to produce is prevented by sliding friction

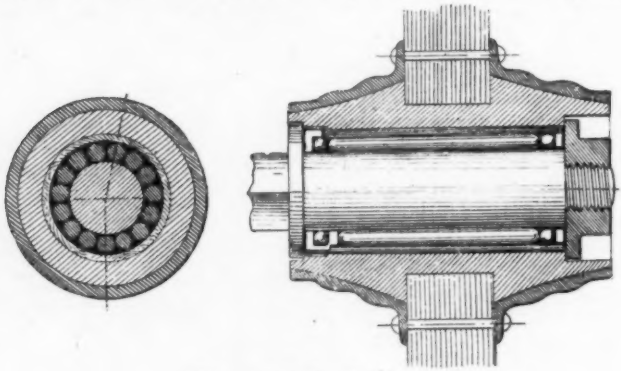


Fig. 17. Roller Bearings

or by an alteration in form of the surface of the road. If we examine a road upon which a vehicle has described a curve at a relatively high speed, we shall observe, provided the road be dusty or its materials be loose, that the groove made by the wheels presents on the external side of the trajectory a very pronounced ridge, a sure indication of the lateral reactions of the tire upon the roadbed.

3.—*Loss of Live Force Due to the Vibrations of the Vehicle.*—The loss of live force due to the vehicle's vibrations, which, produced by the jarring motions of the wheels upon the road, are transmitted and absorbed by the vibrations of the ground and air is a function of the speed, of the flexibility of the springs and of the elasticity of the other vibrating parts of the vehicle. The coefficient by which this factor is affected is such that it is very difficult to make an exact allowance for it in calculations.

Two cases are to be examined according as the carriage is or is not provided with pneumatic tires. In the case of such tires, we can set aside the term function of the speed. If the tires are rigid, it will be well to increase the coefficient of the preceding term by a tenth.*

4.—*Pressure of the Air.*—For the pressure of the air (an elastic fluid) against a surface in motion, we admit the formula—

$$Ta = KSV^2,$$

in which S is the surface of the projection of all the parts of the vehicle upon a plane at right angles with the direction of the motion, that is to say, here, upon a vertical plane parallel with the axles; V^2 the square of the speed expressed in feet per second; and K a numerical coefficient variable within very wide limits with the form and degree of overlapping or the distance of the parts projected.

This formula seems to be theoretically true only for the pressure of water (an incompressible fluid).

For want of special experiments with automobile carriages, we may admit the coefficient 0.0288 for K.

5.—*Accelleration.*—If we wish to take into consideration the supplementary force to be required of the motor at the moment of starting and until the speed of the vehicle becomes constant, we must add to the preceding terms, the term—

$$\frac{P}{g}\frac{dV}{dt}$$

which makes evident the advantage of a slow starting when the necessities of the traffic permit of it.

V.—Axle Journals.—From the moment that the resistant work due to the sliding of the journal upon the side of the axle-box has for expression—

$$Tf = \varphi \frac{F}{D} p,$$

it is necessary to try at once to diminish the relation $\frac{F}{D}$ and the coefficient φ.

The mean diameter, F, of the journal depends upon the quality of the metal used in it, and also upon the load. This quantity is therefore nearly definite for a vehicle of a given weight. On the contrary, we shall see further along that D (the diameter of the wheel) may vary considerably with the arrangements adopted for the vehicle. For the moment, we shall examine only the possible diminution of the coefficient φ.

* In the case of the bicycle, M. Bourlet, from a few experiments made in England, concludes that such increase should be 1/6.

In former times, two-wheeled carts, even when their axles were of iron, had journals that were conical and of a diameter notably less than that of the axle-box, an interval between the two being necessary for the reception of the lubricant with which the journal was surrounded. As the latter left an open space in the rear and front of the box, the lubricant had to be solid in order that it might not be lost.

At this epoch, the coefficient of friction of the journal upon its box was estimated at 220 pounds per ton.

In stage coaches, and still more so in private carriages, it has for a long time been regarded as necessary, in order to diminish φ, to substitute a liquid for a solid lubricant. In order to obtain such a desideratum, it has become necessary to place the journal in a space as perfectly closed as possible.

Such an arrangement is now employed even for the heaviest vehicles, as shown in Fig. 15 in our previous issue, which represents the patent journals of the trucks employed at the Say Refinery for the carriage of 22,000 pounds of sugar in bags. The coefficient of friction has thus been brought to 22 pounds per ton. This value corresponds to the case of the patent journal of a wheel revolving very regularly in a plane without lateral concussions.

In the case of wheels running upon a somewhat irregular pavement, we are led to think that the coefficient of the work absorbed by the friction of the journal upon its box is notably greater. We take as a basis a fact communicated to us by M. Jeantaud, the well-known manufacturer, who one day received from the manager of the Grands Magasins du Louvre an order to provide the house's small delivery hand-carts with patent journals, in hopes of diminishing the fatigue of the men who were obliged to draw them. Great was M. Jeanteaud's astonishment when the manager informed him that the delivery men had complained that they had experienced more fatigue than before. An experiment made by communicating a given speed to wheels provided with a patent journal and to others with an ordinary one, and then counting the number of revolutions that they made before stopping, demonstrated that the first were submitted to a friction ten times less than the second. Notwithstanding this, the delivery men continued to assert that their carts had become harder to draw.

Like M. Jeantaud, we can explain such a result only by the impossibility of relative displacements of the journal and the axle-box in cases of those lateral shocks that occur so frequently in street traffic.

Automobile Tires

By H. Falconnet

ONE of the most important problems in the construction of automobiles—a problem which concerns both the *chauffeur* and the manufacturer—is the provision of a suitable rubber tire. Up to the present time no attempt has been made to classify rubber tires, to describe them briefly, yet clearly, and to state their respective merits impartially. As a result, most automobile-owners merely utter the opinions which they find in the catalogues of tire-makers. Unfortunately, these catalogues are for the most part confined chiefly to a glowing descrip-

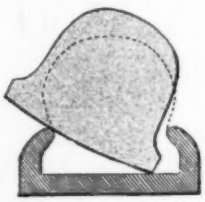


Fig. 1. Forcing the Tire in the Rim

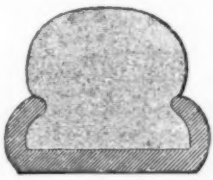


Fig. 2. Tire Fitted in an Inturned Round-flanged Rim

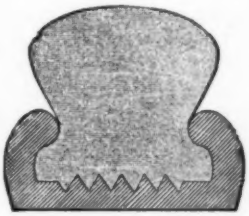


Fig. 3. Serrated Rim

tion of one particular type, and lead one to infer that all tires, with the single, noteworthy exception of the one under discussion, are absolutely worthless. Such flamboyant and extravagant descriptions are, of course, to be taken with a large pinch of salt; for there are many tires made both here and abroad which are very well adapted for motor-carriages. It is merely a question of selecting that system which is best suited for the purpose to which it is to be applied. In this spirit I have endeavored to bring together in the present article all those systems which have proven practicable, and to give an unprejudiced opinion of the advantages of each.

One of the simplest methods which has yet been devised for securing tires in place is the forcing of the rubber within the inwardly-turned flanges of the rim. The tire, as illustrated in Fig. 1, is held in position by the engagement of its recesses with the overhanging flanges, and is glued to the rim by means of an

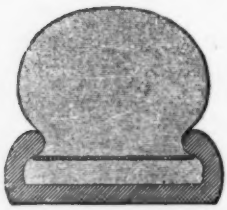


Fig. 4. Tire with Cross-piece

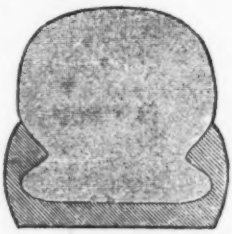


Fig. 5. Tire with Single Lateral Support

adhesive gutta-percha compound. The rim-flanges can be made either straight or round, the latter being the more sightly. The rim shown in Fig. 3 is longitudinally-serrated, for the purpose of preventing a displacement of the tire; but the serrations are not of much value. In another method of holding the tire in place a steel cross-piece is employed (Fig. 4). The rim shown in Fig. 5, formed with a lateral support, is an improvement on this type.

Tires secured by all these means are not very durable; they are soon destroyed by the sharp joints or the steel cross-ties.

By forming the rim with a double support the tire is more effectively secured and better able to withstand hard usage. Figs. 7 and 8 respectively represent a hollow and a cellular tire, held in position by direct engagement with the rim.

Tires are also fastened to the wheel by vulcanization (Figs. 9 and 10). An elastic connection of the tire with the rim is secured by employing four or five successive layers of gradually increasing hardness, the last of which is composed of ebonite. If the wheel be of wood, the tire must be shrunk on the rim, since the high temperature required in vulcanization would render it impracticable to follow the usual method.

Many manufacturers secure their tires to the wheel by mechanical means (Figs. 14 to 19). In the system represented

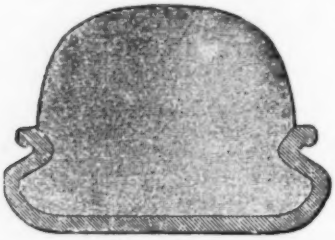


Fig. 6. Steel Rim with Double Support

Fig. 7. Cellular Tire

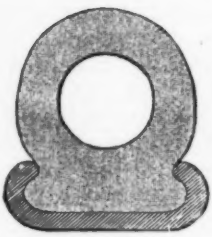


Fig. 8. Hollow Tire

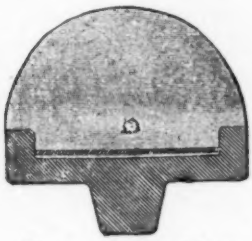


Fig. 9. Rim for Metal Wheels

Fig. 10. Rim for Wooden Wheels

in Fig. 14, for example, the tire is composed of a hard and an elastic portion, a pin being passed through the elastic portion so that its head will hold the hardened portion against the rim. In Fig. 15 a modification of this method is shown. The tire pictured in Fig. 16 is held in position by a tie composed of two curved metallic members, one of which rests on the wheel and the other of which serves as a protecting means for the rubber. Fig. 17 represents a tire secured to its rim by means of wires running longitudinally through the rubber. The same principle is shown in Figs. 18 and 19, the wire being superseded by an interior circular retaining member.

The tires which we have so far described have been either of the hollow or solid rubber types. We now come to pneumatic tires. In the month of June, 1896, a very exhaustive paper was read before the Society of Civil Engineers of France, from which paper I shall make excerpts of those portions in which the principles governing the construction of inflated tires is discussed.

The material employed comprises a rigid base of metal (or wood) on which the rubber is placed. The air-chamber is an

Fig. 11. Single Tube Tire

Fig. 12. Interlocking Pneumatic Tire and Rim

endless tube of pure rubber. Canvas cannot be used; for all textile fabrics are permeable to air under pressure. The rubber tube, being unable to resist high pressure, is incased in an envelope composed of canvas, which imparts greater resistibility to the tube and likewise serves as a protecting jacket for the rubber. The canvas is coated with rubber to prevent its rotting, and is furthermore protected from wear by a thick outer covering of rubber. This exterior rubber covering is crescent-shaped in cross-section and is separated from the envelope proper, so that it can be readily removed and a new one substituted whenever it may be necessary.

The envelope is fastened to the rim by innumerable methods. As a general rule it is held in place by overhanging, inturned,

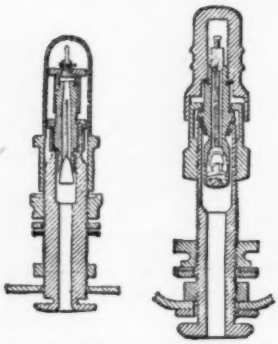


Fig. 13. Valves for Pneumatic Tires

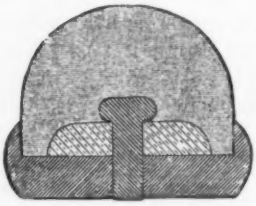


Fig 14. A Rubber Tire Pinned to the Rim

Fig. 15. Tire Secured by a Stud Embedded in the Rubber

locking flanges on the rim, which engage correspondingly-shaped portions on the tire. The tire is also pinned to the rim so that it cannot be dislodged. This method of fastening the envelope presents obvious advantages over those systems in which the tire is held in position merely by the air-pressure within the tube. If the pressure diminish, the envelope may become entangled in the spokes and cause serious accidents. Other means of securing the tire (by bolts and the like) have not been very successful.

Rubber tires are composed of Para gum, so prepared and disposed as to secure a maximum resistance at every point to all those strains which tend to destroy a tire. Evidently the forces which affect the central portion will not be the same as those to which the outer surface and the base are subjected. A substance may be capable of resisting friction, but may not have the resiliency

required; another substance may be capable of withstanding great pressure, but may be unable to resist tractive forces. It is natural, therefore, that so many inventors should have endeavored to devise some form of tire which would answer the multifarious requirements of the automobile. Some manufacturers have confined their efforts to the production of a perfectly seamless rubber tire; others have sought to lessen the inconveniences which attend the removal of the tire from the rim and its replacement.

Of all the tires which have been invented for the purpose of overcoming the obstacles mentioned, the compound tire seems to have given the best results. Experience has proven that it is admirably adapted to the automobile and that it is free from many objections to which the pneumatic tire is open.

The method of securing the compound tire to a steel rim is similar to that employed in pneumatic tires, laterally projecting

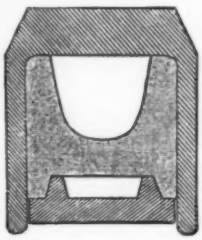


Fig. 16. Tire with Metal Shield

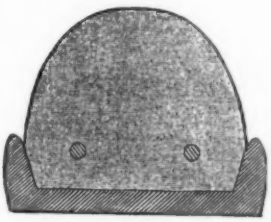


Fig. 17. Tire Secured by Longitudinal Wires

flanges and pins being used. In most systems the steel flanges of the rim have a tendency to cut the tire; in the compound system, on the other hand, the flanges serve as a double support for the rubber. Pins are chiefly employed for the purpose of preventing a displacement of the tire when suddenly wrenched.

When steel rims are used, care should be taken that there is no possibility of cutting the rubber. The form should be such that a permanent and an auxiliary support are provided, the former of which receives the tire under normal conditions and the latter of which serves to retain the tire when, by reason of a sudden wrench or other cause, it shows a tendency to spring from the rim. The rim flanges, moreover, should be sufficiently inturned to engage the recesses and laterally projecting portions of the tire. To prevent possible contact with the road, the rim should also be outwardly curved to form protecting wings of steel.

The firmness with which the compound tire can be held in position, its resiliency, the readiness with which it can be removed, the impossibility of its being cut by steel rims of proper shape, its freedom from joints and its ability to withstand long and hard usage render it particularly applicable to the automobile.

The considerations which should govern the automobilist in the selection of a tire are so many that it will be possible to mention only the most.

The first point to be considered is the type of motor used. If the motor comprise delicate mechanism, if it be incapable of withstanding shocks, then a tire of great elasticity should be selected.

Although the inherent disadvantages of the pneumatic tire are reduced to a minimum in the tricycle, they are often a source of trouble in light carriages. The weight of the vehicle should, therefore, receive some attention in the choice of a tire. In carriages weighing more than 600 pounds only seamless tires should

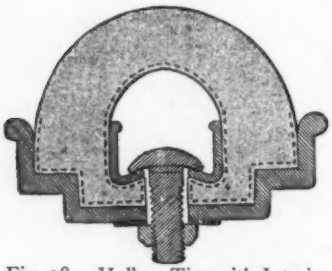


Fig. 18. Hollow Tire with Interior Retaining Members

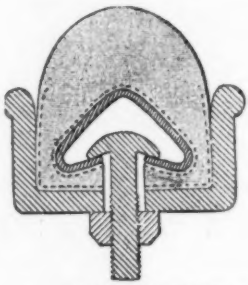


Fig. 19. Solid Rubber Tire with Interior Retaining Members

be used; and the rubber should be secured to the rim either by vulcanization or by some equally serviceable method.

A vehicle whose wheels are provided with pneumatic tires will hardly require springs. But if the carriage body be supported on the axle by springs, the difference in resiliency between the solid rubber and pneumatic tires is not so apparent, and is well-nigh inappreciable when the compound tire is employed.

Tires on vehicles which are used only in the limits of a city should be wide enough to prevent their binding in the tracks of street-car railways. When a carriage is used for touring and the automobilist does not desire to carry with him a repair kit, the pneumatic tire will not be of much use; for the best pneumatic tire is apt to be punctured, no matter how carefully it is made.

The statement holds good for delivery wagons, physicians' carriages, and for all vehicles in which absolute safety and certainty are required.

If the speed of a carriage be high, the centrifugal force will have a tendency to throw the tire from its rim; but engagement with the ground will tend to force it back into place. These two opposing forces acting on the tire destroy the rubber prematurely. For speeds of 15 to 18 miles per hour it is, hence, advisable to use tires composed of an endless ring of rubber without any transverse joint. The tires should be either vulcanized to the rim or held in place by mechanical means.

The advantages of vulcanizing a tire to the wheel are offset by certain disadvantages. If the wheel be of wood, the rim must be removed in order to substitute a new tire for the old. With

Fig. 20. A Compound Tire

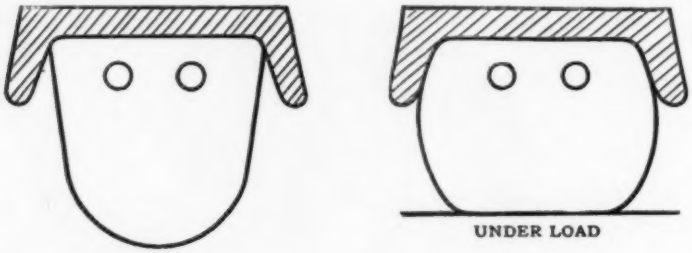
all-metal wheels these difficulties disappear and vulcanization will be found to give excellent results.

A pneumatic tire, in the end, is a rather costly contrivance; for the constant repairs which are required by the outer covering, the canvas envelop, the air-tube, and the valves are often very expensive. Of solid rubber tires, the most economic and to a certain extent the most elastic are those having the greatest width and height. The wider the tire the smaller will be the pressure of the load per unit of surface, and likewise the strains which tend to wear away the rubber and destroy the tire. The higher the tire, the greater will be the surface provided for securing the rubber to the rim. The high tire, however, has the defect of being more readily torn from the rim under the influence of the lateral force exerted in withdrawing it from a rut or track. The

more elastic the rubber, the smaller will be the danger of cutting the tire; for the material will yield under the pressure of an obstacle and thus possibly prevent an incision.

Except in those cases where the character of the motor requires a tire of unusual resiliency, those tires should be used which insure safety, comfort and economy.

Tricycles and light carriages without springs can be fitted with pneumatic, hollow or compound tires. For automobiles up to 1,000 pounds in weight (the load being equally distributed on the axles), almost any tire can be used; but the quality of rubber used and the means of attaching the tire to the wheel will affect the life of the tire. If great resiliency be necessary, the pneumatic, hollow, or compound tire should be employed. The compound is better than any solid rubber tire, because it always



NORMAL UNDER LOAD

retains its form and is not so readily chipped. For automobiles varying in weight from 1,000 to 10,000 pounds it is not advisable to employ tires with transverse joints, or those which are hooked, pinned, or wired to the rim. The disadvantages attending the use of such tires are obviated by employing very elastic compound, or solid rubber tires, or tires vulcanized on the rim. For vehicles weighing from 10,000 to 20,000 pounds, the tire should be vulcanized on the wheel to obtain the best results.

A few words regarding the care and preservation of tires will not be here out of place.

As a general rule, the manufacturer should be immediately informed of any signs of weakness and of unusual wear in a tire. Slight injuries can be almost always repaired as soon as they have occurred. When the transverse joint of an ordinary tire, for example, has parted, repairs can be made if the accident be of recent occurrence; otherwise the injury is irreparable.

With tires less than 1½ inches in diameter care should be taken in traveling over streets covered with large paving-stones;

for the tire often enters the crevices between the stones, and the load being borne only by the sides, the rubber is often cut. A journey of 120 miles on a badly-paved street, where the vehicle is traveling at a high rate of speed, will produce as much wear on the tire as a journey ten times longer on an ordinary road, and at a reasonable speed.

If the tire be not of the endless ring type and the joint show a tendency to part, the lateral retaining devices should be readjusted and wire passed transversely around the tire to hold it to the rim.

The switch-tongues of railway tracks should be avoided, for they are a source of constant danger to the automobilist, especially when the tires are less than 1½ inches in diameter.

The brakes should be gradually applied and the sudden stops produced by the rim-brake avoided. The friction-roller brake is perhaps the best for automobiles. If a rubber brake-shoe be employed, particular care should be exercised to avoid lateral strains.

The carriage should be steered only at reduced speeds.

If the rubber of the tire has been deeply cut, the incision should be cleaned with benzin and melted gutta percha poured in the cut. Even if the injury be not repaired, the cut should be thoroughly cleansed of sand.

The rubber should never be allowed to come into contact with lubricating-oil.

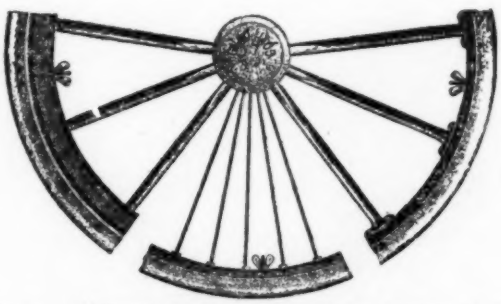
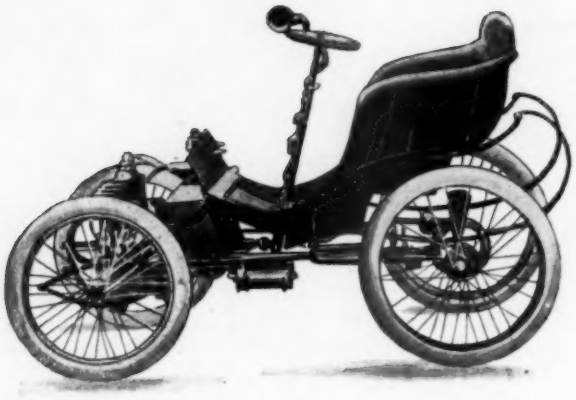
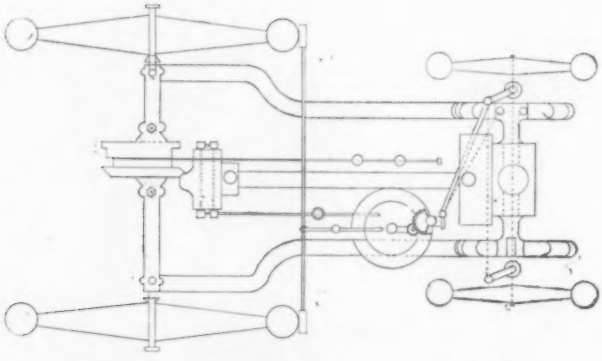


Fig. 21. Different Methods of Mounting a Compound Tire



Hertel's Voiturette

IN Hertel's Voiturette, named "The Impetus," the motor is placed between the front wheels over the springs. The motor is supplied with air-cooling flanges, and has a speed change working by two brakes manipulated by a single lever. These brakes also serve alternately to detach each of the two gear chains.



The carriage, when supplied with a motor of two and a half horse-power with cooling flanges, or a three horse-power with water jacket, is said to be capable of covering 33 kilometres in one hour.

A Power Increasing Motor

By Henry Sturmey

EARLY this year the first trials upon the road of a new car has been made by Messrs. Dawsons, a firm of engineers of Canterbury, England, which possesses many novel features, but more particularly relating to the engine construction. Hitherto the great advantage of steam over gasoline for automobile traction has been its flexibility, and it is just this flexibility which is possessed by the steam engine which Messrs Dawsons have succeeded in giving to their oil engine, with a result which is simply astonishing to those who know the limitations hitherto characteristic of the oil motor. We are not yet in possession of minutely detailed particulars of the invention, but we may say that its broad principle of construction consists in the combination of compressed air with the gasoline charge. Ordinarily the engine works as an autocycle explosion engine, but the cylinders are extended in the direction of the crank chamber in the form of an additional cylinder of larger diameter, which is used as an air pump having an area equal to the difference of the two diameters. In ordinary action the valves connected with this portion of the motor remain open, and, with free circulation of the air through the walls of the cylinder, it moves without perceptible additional friction, and the motor is in all respects identical with an ordinary autocycle explosion motor. But this additional cylinder has three functions which can be utilized at will to obtain with the motor all the flexibility of power and action that is obtainable with a steam engine. In the first place, the valves can be so shifted that the secondary cylinder becomes an air force-pump, which compresses air into a cylinder provided for that purpose under the driver's seat. By reversing the position of the valves this compressed air can be passed back again through the air pumps, which, by the reversal of the valves, become air motors, and by this means the petroleum action can be functioned at will, a touch of the valve lever causing the motor to be instantly started automatically, so that there is no need for the driver to be getting down out of his carriage and turning the usual handle. Not only is the power thus obtained sufficient to start the motor when disconnected from the carriage, but it will start and propel the carriage itself some little distance, if need be, though, of course, this is not, as a rule,

necessary. Again, by an alteration of the valve gear the air motors can be started backwards, and thus the motor can be automatically set going reversed, so that no reversing gear in the car is required, this reversal, as well as the starting, being entirely automatic and effected by the merest touch of the finger upon the valve lever, and, of course, the motor, which is timed to fire at the dead point, will give equal power backwards as forwards; but the chief advantage obtained by the use of the secondary cylinder air system is the obtaining of additional power when required for hill work. This is not, as might at first be supposed, effected by assisting the gasoline system with the power of the compressed air system, but does not need the air storage tank at all, and Messrs. Dawsons have a second pattern of engine which dispenses with the automatic starting and reversing, and uses this automatic power accelerator device only. And the way it is done is this: By a suitable manipulation of the valves the air contained in the air cylinder is caused to pass into the forward end of the gasoline explosion cylinder at the moment of commencing its return stroke. This being the exhausting or emptying stroke, the exhaust is not only expelled by the backward passage of the piston but is swept out by a blast of fresh air, and thus the interior of the cylinder is more effectually cleared of the waste gases than could otherwise be effected; the charge which it then takes in is consequently of a purer and richer character, and this in itself is an advantage, but when the following return of the piston takes place on the compression stroke, this action is preceded by the admission into the cylinder of atmospheric air forced into it by the air pump at a pressure of about ten pounds to the square inch. This has the double effect of increasing the initial pressure of the charge and consequently vastly increasing its ultimate pressure at the moment of explosion, with a corresponding increase in the power of the stroke, and it also enriches the charge itself and thus gains a further advantage, and, if necessary, the amount of air so mixed with the charge can be still further increased and the amount of gasoline vapor admitted increased likewise to correspond, thus still further increasing the effectiveness of the engine, whilst the repeated admission of cold air into the cylinder between the strokes helps materially to keep the internal heat down. The result of this arrangement is that, when ascending long, steep hills, or meeting with other work necessitating increased power, the power of the motor can be virtually doubled.

The Bosch Magneto-Electric Igniter for Automobiles

AT the Berlin Automobile Exposition the firm of Robert Bosch, of Stuttgart, exhibited magneto-electric ignition apparatus of various sizes, remarkable chiefly for the simplicity of their construction and the astonishingly large number of sparks obtained per minute.

In the hydrocarbon motors so widely used in Europe for driving carriages the ignition devices constitute one of the most important features. Of igniters there are two kinds—ignition tubes and electric-spark apparatus. The latter may obtain their electric energy either from batteries or miniature magneto-electric machines. Despite the many disadvantages attending the

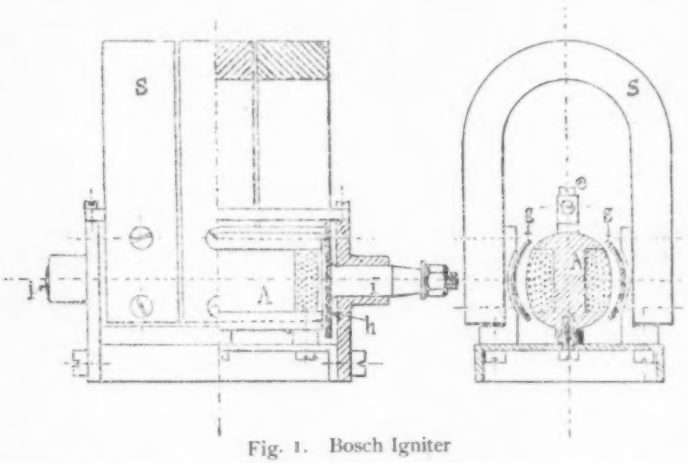


Fig. 1. Bosch Igniter

use of ignition-tubes, the only form of electric gas-exploding device which has been more or less widely used is the induction-coil energized by a battery current. But its sensitiveness to moisture, the care which it requires, and the frequent occurrence of short circuits have caused the battery to be abandoned by many *chauffeurs* for the magneto-electric machine.

For a number of years magneto-electric machines have been successfully used on stationary explosion engines making but a small number of revolutions per minute. But mechanical reasons prevented the application of this system of ignition to automobile

motors. Finally Robert Bosch, of Stuttgart, succeeded in devising a magneto-electric machine which was applicable to fast and slow running motors alike, and thereby overcame an obstacle which had long baffled inventors.

Before describing the construction of this new apparatus, it should be remarked that its underlying principle is essentially the same as the magneto-electric igniter which for the past thirteen years has been used on stationary motors. Experience has proven that the magnetism of these machines is well-nigh permanent and that they are subject merely to wear. It should be remarked, furthermore, that the ignition is no wise affected by moisture and that, even though the apparatus be deluged with water, sparks will still pass between the terminals. The ignition is not influ-

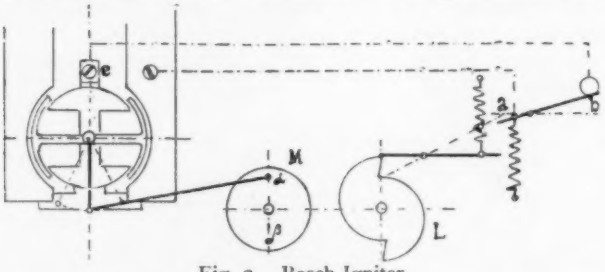


Fig. 2. Bosch Igniter

enced by atmospheric conditions; nor is it possible to ignite spilt benzin or any other hydrocarbon, since the sparks are produced only within the motor-cylinder.

If about the bar *A* (Fig. 1), insulated wire be wound, and a magnet *S* be brought in proximity with and removed from the ends of *A*, then an electric current will be generated in the wire, the intensity of which depends upon the rapidity with which the magnet approaches and recedes from *A* and upon the strength of the magnet. If the armature *g* of the apparatus be given an oscillating movement, the same result is obtained as when the magnet *S* approaches and recedes from the ends, *i. e.*, the cylindrical surfaces of *A*. Electric currents are set up by this oscillation. If the circuit through which these currents are flowing be broken, sparks will be produced at the point of interruption, which sparks are admirably adapted for the ignition of explosive mixtures of air and gas.

An experience gained in constructing igniters for stationary motors proved to the inventor that the following conditions should be observed in making gas-exploding devices for automobiles:

The Bosch Igniter

The winding of the core should be secure in order that—

1. The connection of the one end of the winding with the insulated electrodes in the cylinder shall be constant, so that the employment of a collector is rendered unnecessary. (A collector is subject to much wear and cannot readily be kept clean.)

2. The current from the other end of the winding (which end, for the sake of simplicity, is directly connected, in such apparatus, with the iron of the core) shall not flow through oily and dirty bearings into the motor frame, but from the core over good, non-resistant surfaces to the electrodes.

3. The moving parts, which, for mechanical reasons as well as for the purpose of obtaining the speed necessary in ignition, are merely oscillated, shall not be too heavy, for otherwise the wear upon the driving mechanism would be inordinate.

These conditions are satisfied in the following manner:

The core *A* of the apparatus (Fig. 1 is firmly screwed to the base-plate; and between the hollowed poles of the magnet *S* and the core *A*, a cylindrical armature *g* is arranged, from the covering of which two longitudinal strips are cut. The armature *gg* is secured to the plates *h*, into which the ends of the shaft *i i* are fastened.

The igniters can be arranged in any manner desired. In Fig. 2 such an arrangement is diagrammatically represented. To the driving shaft of the motor, a disk *M* is secured, with which an eccentric *X* is connected. To the shaft of the apparatus a lever-arm is fastened, which is in turn connected with the eccentric *X* by means of a pitman. When the driving shaft is rotated the armature is oscillated and a current is generated. To the binding-post *a*, with which the polished end of the winding is connected, a wire conductor is fastened, leading to an insulated electrode. By means of a coiled spring, the end *b* of the lever *a b* is brought into contact with the electrode. A wire secured to the lever *a b* runs to the igniting apparatus, which wire is really unnecessary, since the body of the motor could take its place. The end *C* with the insulated electrode is located in the cylinder (not shown). Upon the driving-shaft or any other shaft operatively connected therewith, a shouldered cam *L* is secured, the periphery of which is in contact with one end of a second lever, the other end of which is adapted to strike the end *a* of the first lever *a b*. When the parts are set in motion, sparks are produced between the terminal rods whenever the end *b* of the first lever is withdrawn from the insulated electrode and the circuit thereby broken.

The "Enomis" Odometer

THE question of odometers for automobile carriages has often been studied by manufacturers, but two great difficulties have always been encountered: (1) that of giving adequate strength to an apparatus that must resist all vibrations and shocks, and (2) that of regulation, which is different on every carriage, since a uniform diameter for wheels has never been adopted for automobiles, as it has been for bicycles.

An odometer, in order that it may be perfect, must therefore combine the two qualities of great strength and variable multiplication.

The "Enomis" odometer, which we illustrate herewith, may be placed indifferently upon all carriages, since it is capable of being regulated. The possibility of regulating these apparatus will be seen to be a very great advantage when we come to consider that the diameter of wheels often varies, either because of the escape of air from the pneumatic tire or the wear to which the solid tire has been submitted.

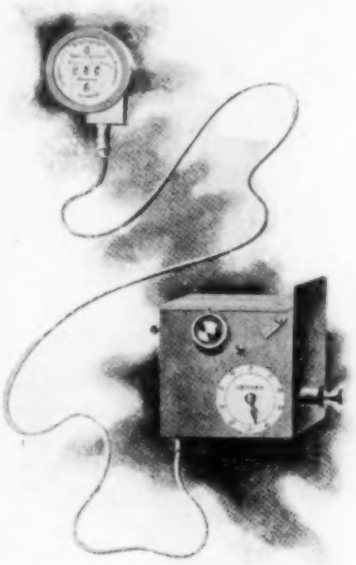


Fig. 1. The "Enomis" Odometer

Let us study in a mathematical manner the case of a wheel provided with a solid tire. Let us take a wheel 1 metre (3.28 feet) in diameter, the rubber tire of which is 3 cm. (1.18 inch) in thickness, which is normal. This wheel, when new, will cover a distance of 3.14 metres (10.3 feet) at each revolution of the crank. After the tire has become worn and is but a centimetre (.39 inch) in thickness, the diameter will have been reduced by 4 centimetres (1.57 inch), say to 96 centimetres (37.8 inches). We therefore have a loss of 13 centimetres (5 inches) in 3.14 metres (10.3 feet), say 41 metres (134.5 feet) per kilometre (.6 mile; *i. e.*, 224 feet per mile). It

is therefore indispensable that there shall be a possibility of regulating the odometer in measure as the wheels wear. When the multiplication is fixed, such regulation is extremely difficult, since it is necessary to change the gearings. In the odometer under consideration, this operation is exceedingly simple, and may be performed along the route. It suffices to revolve a button in one direction or the other in order to set the multiplication back or ahead.

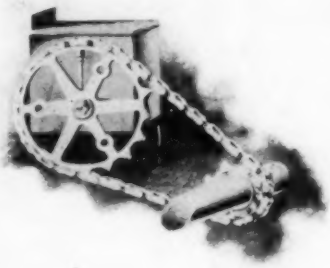


Fig. 2. Mounting of the Box Containing the Multiplying Gearing

The "Enomis" odometer (Fig. 1) consists of two distinct apparatus: (1) a box containing the multiplying-gearing (Fig. 3); and (2) a kilometric registering-apparatus (Fig. 4). These are connected with each other by a rubber tube that transmits the motion of the multiplying gearing to the registering-apparatus. Let us first examine the box enclosing the multiplying-gearing. This is placed near the differential shaft, with which it is connected by a chain actuated by a sprocket (Fig. 2). This method of control is infinitely superior to that effected by a trip placed directly upon the wheel. The trip, in fact, gives an abrupt shock at every revolution of the wheel, while the chain transmits a continuous and regular, and, consequently, a much smoother and more exact motion. Moreover, since the differential shaft revolves with greater velocity than the wheel, the regulation is on that account of much greater precision.

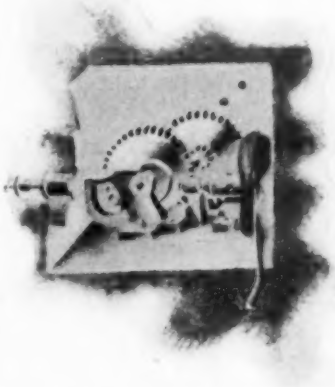


Fig. 3. Section of the Box Showing the Gearing

The variation in velocity is obtained through a disk (Fig. 4) over which moves a roller that may be made to recede from or approach the centre. Such regulation is of extreme sensitiveness;

and a half-revolution of the button suffices to cause the apparatus to gain or lose two or three metres per kilometre (about 11 or 16 feet to the mile). It therefore suffices to turn the external screw to the right when the odometer is running behind, and to the left when it is running ahead.

The transmission of motion is done pneumatically. At every hundred metres (328 feet), a lever strikes a rubber bulb, which, through a tube, transmits the motion to the kilometric registering apparatus. The pressure of the lever upon the bulb is obtained by means of a hammer situated at the exterior of the box. The degree of pressure upon the bulb is regulated by a screw at the extremity of the lever. Such a regulation, however, scarcely ever has to be effected, since the apparatus are delivered fully regulated.

Fig. 4. Regulating Apparatus

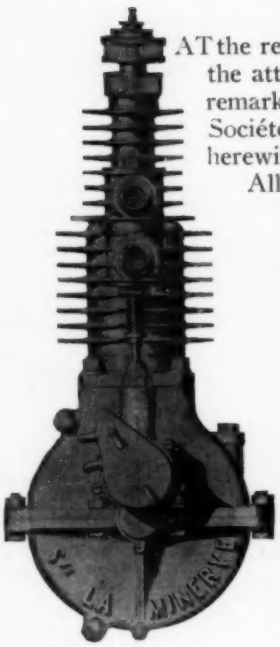
After the carriage has stopped, or when it is not desired to use the odometer, the collar of the pressure-spring must be screwed in such a way as to hold the hammer back. As the spring then no longer acts upon the lever, the odometer will be at rest.

As for the kilometric registering-apparatus, we have to consider:

(1) The Regulation.—The apparatus is provided with five dials, and is capable of marking distances up to 10,000 kilometres (about 6,200 miles). At every 100 metres, the figure of the hectometres changes and carries the other dials with it.

(2) Setting Back to Zero.—In order that the setting back to zero may be quickly done, it is effected through three axes—hectometres, kilometres and myriametres. In this way, the operation (which is performed by means of a key furnished with the apparatus) is effected in less than half a minute.

The Minerva Motor



AT the recent Motor Competition at Aubervilliers, the attention of the public was attracted by a remarkable motor which was presented by the Société La Minerve, and which we illustrate herewith.

All explosion motors are subject to an excessive heating of the sides of the cylinder which interferes with the regularity of the explosions and renders the operation of the apparatus irregular just at the moment when there is most occasion to rely upon it; for example, when, in order to climb a long and steep acclivity, the explosions are hurried and the quantity of heat developed is thereby increased. Although flanges and circulations of water afford a means of averting such an inconvenience, they are merely inadequate palliatives, since, although the external sides of the cylinder allow their excessive heat to disengage itself, the internal sides and the piston do not get rid of it fast enough, and may be raised to such a temperature as to render lubrication impossible and thus cause the segments to gripe and injure the walls of the cylinder.

The originality of the " Minerva " motor consists in causing a current of air to pass into the interior of the piston so as to add a very efficient internal cooling to the external cooling produced by flanges. To this effect, the piston, which is hollow, is prolonged by a tube that forms a second piston which slides in a cylinder smaller than the explosion one. This tube, like the larger piston, is provided at its upper part with segments that assure the tightness of the apparatus and prevent the gases due to the explosion from escaping through the annular space left around the tube in order to prevent friction. In this way, the interior of the principal piston, and, consequently, the interior of the casing, are in constant communication with the external air, which

is sucked in and forced out through the tube and assures the cooling of it to such a degree that stationary motors of this type have been able to withstand compressions of 650 pounds to the square inch without the maximum temperature exceeding 280° C, after a certain period of operation. When the motor operates upon a motocycle or a voiturette, a cooling by a circulation of air in the flanges is added to the internal cooling and prevents the temperature from rising to more than 150° C, even after several hours of running. This is an inappreciable advantage which, it is claimed, renders the "Minerve" motor infinitely superior to all the explosion apparatus that have made their appearance up to the present time; and, as the other parts are like those of motors of the same class, the addition that has been made to the "Minerve" may be applied to other motors so as to suppress the manifold inconveniences to which automobilists are exposed.

A lubricator, especially devised for the purpose, assures the perfect lubrication of the secondary piston.

The "Minerva" motor of the type M. A., which is the one now being constructed, and which has been submitted to experiment, is warranted to give, at the brake, an effective power of 957 foot-pounds, say an effective 1¾ horse-power. It weighs 748 pounds and occupies the same space as other motors of the same class. Other and more powerful types are in preparation and will soon be offered to the public.

A MOTOR VEHICLE DEFINED

At an English police court recently Captain Herve H. A. Errington Josse, of Norman Villa, Bargate, Grimsby, was summoned by the Inland Revenue for keeping a carriage without a license.

The question raised was whether a vehicle consisting of a car attached to a motor cycle was one carriage or two. If it was considered as one the maximum traveling speed allowed would be twelve miles, and if as two, six miles per hour.

The magistrates decided that it was one vehicle, and imposed a fine of one guinea.

The Loutzky Automobile

THE Berlin automobile exposition gave German *chauffeurs* an opportunity of examining Loutzky carriages of various types. The Loutzky exhibit included two *voiturettes,* an automobile mail-wagon, two tricycles, and four traction-*voiturettes.* Of these nine vehicles, the two seated *voiturette* and the mail-wagon deserve more than a passing notice.

The *voiturette* in question is driven by a four-cycle, double-cylinder, hydrocarbon motor developing 3½ H. P. and making 1,200 to 1,500 revolutions per minute. The cylinders are cooled either by flanges or by water-jackets; and the carburetted gases are discharged by electric spark. The admission and exhaust valves are controlled by a single cam acting on two levers mounted in a common vertical plane, with their extremities separated by an arc of 90°. The gears, intermediate shaft and operating-

lever, as well as the motor-shaft and fly-wheel are inclosed in a casing which serves as a support for the cylinders.

The water-tank, in the jacketed type of engine, has a capacity of 4.4 gallons and is mounted in the forward portion of the carriage between the two steering-wheels. The water is circulated by means of a reciprocating pump.

The motor is arranged under the carriage-seat, between the two rear driving-wheels. Gearing directly connects the motor-shaft with the driving-wheels. Adjacent to the motor are mounted a petroleum-tank with a capacity of 4.5 to 6.6 gallons, the accumulators, and the spark-coil.

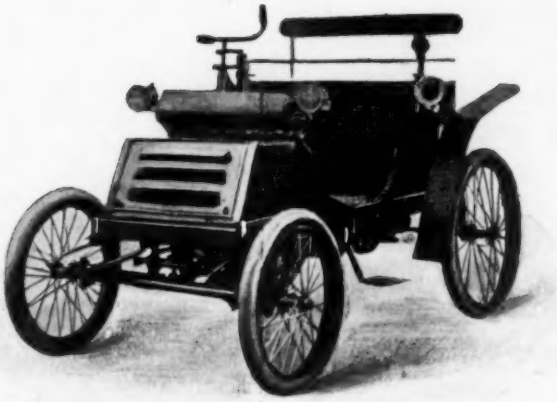
The carriage is provided with two changes of speed, the pinions and spur-wheels composing the gearing being respectively proportioned in the ratio of 1 to 9 and 1 to 17, corresponding in the former case with a speed of 15.5 to 21.7 miles per hour on a level road; the other change of speed is used on heavy grades. The intermediate speeds are obtaining by varying the proportions of the explosive mixture and by properly controlling the ignition. The speed-changing gear is thrown into and out of engagement by means of two friction clutches connected with a single lever mounted on a post upon which are also carried the steering-wheel and two hand-levers connected with the carbureter and igniters.

Steering is effected by means of a divided axle connected with the two front wheels, held in forks, as in bicycles.

In the remaining details of construction the carriage resembles most automobiles of the same type. The weight varies between 500 and 550 pounds.

MUNICIPAL ENTERPRISE ABROAD

The City Surveyor of Birmingham recommended his council to purchase a motor vehicle for heavy work. It has now for some time been in use, and he reports a saving of 50 per cent., as compared with the cost of performing similar work with horse-drawn vehicles. For some time past the Chiswick Vestry have employed motor dust-carts, and they report favorably on them; and the Mersey Docks and Harbor Board are now employing heavy motor vehicles.



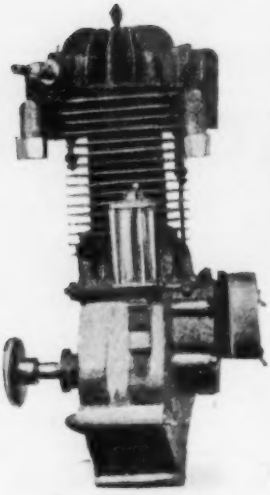
The Pougnaud-Brothier Naphtolettes

IN the types of "naphtolette" brought out by Messrs. Pougnaud and Brothier, the motor has been mounted in the front of the carriage, for the reason that it can be more easily reached. Power is transmitted by gearing and by belts, whereby the inconveniences attending the use of the chain have been done away with.

In the carriage which is known as "Type C," two pinions on the motor-shaft engage two gear-wheels mounted on an intermediate shaft. Upon this intermediate shaft a pulley or drum is also carried, which receives a belt running beneath the carriage over a fast and loose pulley in the rear. The rear pulley shaft is geared with the differential carried on the rear axle.

In Type D the front pulley or drum is secured to the motor-shaft. The speed-changing gear is mounted between the rear pulley-shaft and the shaft of the differential. This type of carriage was designed to provide a means for increasing the adhesion of the belt and reducing the third speed as much as possible when the carriage was ascending heavy grades.

The motor used is the invention of Pougnaud and Brothier, has a stroke of 4 inches, makes 1,300 revolutions per minute, and



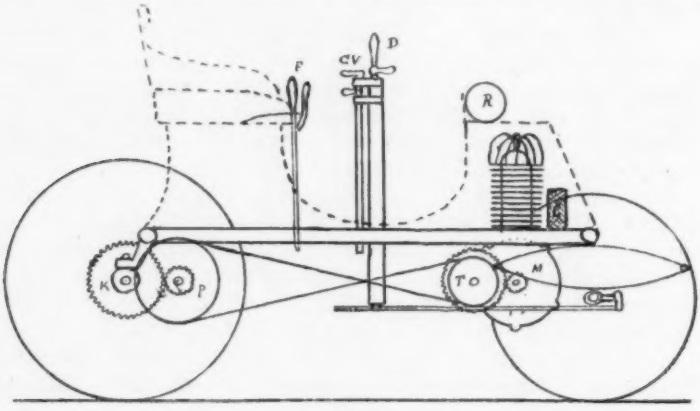
develops 2½ to 3 H. P. The cylinder is cooled by flanges, whereby the inconvenient water-jacket is dispensed with. The two valves, which hitherto have been arranged one above the other, have been placed at each side of the working-chamber, so that they can be easily reached. The exhaust-valve is not raised by the cam usually met with in automobile-engines, but by a lever.

The electric igniter used derives its energy from a powerful primary battery or from accumulators, the electric current being conducted to the usual spark-coil. The igniter is so mounted that it can be readily inspected.

In the carbureter, the intake-valve is reseated by means of a spring. The casing in which the valve is inclosed is so arranged that the air admitted can be either warmed or chilled, the proportions of the explosive mixture varied and the size of the valve-opening regulated, and the quantity of the explosive mixture admitted to the cylinder increased or diminished.

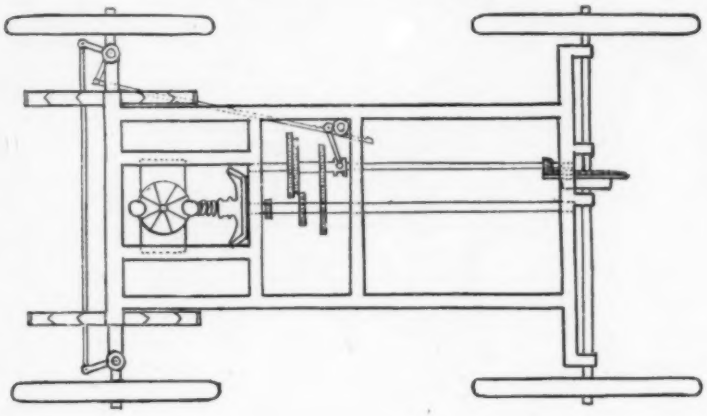
The carriage is steered from the front wheels, which are mounted on a divided axle. The steering-gear is perfectly trustworthy in operation and enables the driver to make very short turns.

Connected with the hollow steering bar are two concentric



tubes, each terminating in a hand-lever. The one hand-lever controls the speed-changing gear and the other the mechanism for shifting the belt from the fast to the loose pulley. By shifting the belt only partially, the carriage can be gradually stopped and started without any shock whatever. By shifting the belt in this manner the speed can be changed without effort, shock, or noise. The steering-bar is also provided with two small levers controlling respectively the ignition and the admission of gas to the cylinder.

Two powerful band-brakes, one commanding the pulley-shaft, the other controlling the rear wheels, enable the driver to stop his vehicle almost instantly. The motor, if it be so desired, can be used as a third brake in descending steep grades.



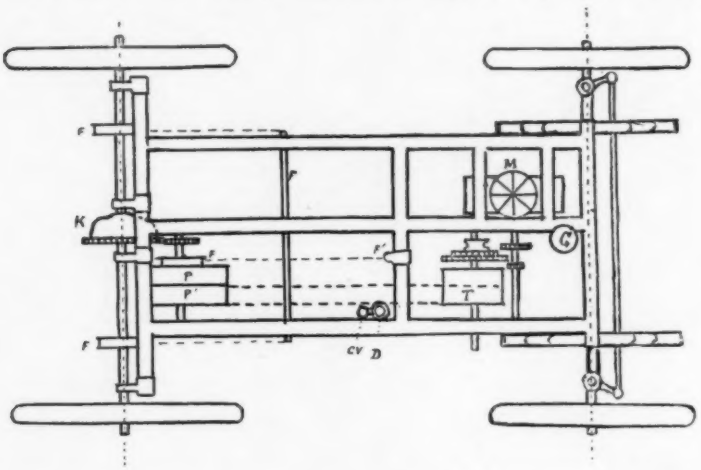
Under the driver's right foot is a belt-tightening pedal, which, however, is used but rarely.

The frame of the vehicle is composed of stout tubes which retain their shape permanently and which support a body that can be removed very readily. The body can be provided with a hood, a special top, a baggage-carrier, or a commercial traveler's sample box. The body is carried by springs, which, together with the pneumatic tires, break the force of all shocks and relieve the carriage of undue strains.

In other types the carriage is provided with two changes of speed, which, by means of the ignition, belt-shifter, and gas-admission cocks, can be varied from 0 to 19 miles per hour. A third speed of 4 to 6 miles per hour can also be obtained. By changing the proportions of the differential gear and coacting pinion, the speed can be raised or lowered.

For those *chauffeurs* who are opposed to the transmission of power by belt and pulley, Messrs. Pougnaud and Brothier have provided a friction-clutch mechanism which is used on the carriage known as "Type E." The exterior is exactly similar in appearance to that of the other type. As the plan view which forms the subject of Fig. 5 shows, it is essentially the same carriage, provided with the same frame, but with differently-arranged cross-bars, and with the motor mounted transversely in the front. The motor actuates the driving-shaft by means of a friction-cone. This shaft is longitudinally disposed as in the case of the single intermediate shaft.

What has been already said on the subject of speeds, steering-



gear, and brakes, in connection with types C and D, applies equally well to type E, of course with the exception that there is no belt tightener or shifter.

In all types the operative mechanism is easily accessible. It is always placed beneath the frame so as to lower the center of gravity and render the carriage as stable as possible, even when running at high speeds or turning sharp corners. For similar reasons the seats have been placed very low, without, however, inconveniencing the occupants by reason of the dust.

All the parts have been arranged so that they can be easily examined, cleaned, and renewed. So simple is the construction of the carriage that the *chauffeur* requires little or no mechanical knowledge to understand his *teuf-teuf*.

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Editorial Comment

THERE is a sort of grim humor in the idea of the exclusion of automobiles from cemeteries, as instanced in the recent action of the trustees of the Forest Hills Cemetery at Boston. As the Boston *Herald* remarked on the matter, "It is but fair to say that the automobiles are not headed that way."

It was the senior James Fiske, we believe, who declined to subscribe toward building a fence about the village cemetery, saying that there was no use for a fence; those who were inside could not get out, and nobody who was outside wanted to get in! The exclusion can hardly work any hardship to automobilists, for there is no motive for them to want to get into a cemetery. It is true that there are apt to be some stretches of good road there. But it is no place for pleasure-driving. And with the miles and miles of boulevards and other perfect roads about Boston—even though motor-vehicles are still excluded from the public parks after ten o'clock in the morning—there is nothing that should tempt an automobilist to explore the mortuary precincts of Forest Hills. The cemetery trustees, however, are said to have had visions of the horrible consequences of a stampeded funeral procession, with horses wildly cavorting across lots, demolishing costly marble tombstones, and attended by other incidents incompatible

with the solemnity of the occasion. A remedy suggests itself. But, while automobile weddings are getting to be the thing—and there was a very interesting one in Boston the other day—we have yet to hear of an automobile funeral. In the City of Mexico, to be sure, there will soon be nothing but trolley-car funerals. All funerals there have long been conducted on the street-cars, which run to all the cemeteries around the capital for the purpose. And now that the street-railway system in the City of Mexico is undergoing transformation to electric traction, the way to the grave will be entirely by that method. The automobile-hearse may wait, however. It is doubtless on the way, but nobody appears to be in any hurry for it.

A Bright Future

"To the victor belong the spoils." It is to the emoluments of political office that this paraphrase of the ancient looting cry of "Væ Victis" is mostly applied here in America, but the developments in the mechanical and scientific world during the latter part of the century now closing would make it equally applicable to inventions. Machinery has at every stage of advancement put aside manual labor. At the same time it has provided for its ultimate employment. Machinery invented to do the work of hands has not worked injury to the man who owns them, on the contrary it has elevated and improved his opportunities. As with man and machinery, so it will turn out to be with the horse and machinery. Where the locomotive displaced the lumbering stage coach and the still clumsier freight wagon, it did not displace horses. It forced them to other uses. The horse is still "man's best friend." But the horse must now measure himself with another no less formidable rival. No matter what the difficulties or the impediments encountered, the evolution of the horseless carriage, the horseless truck, or the great horseless freight wagon is a certainty. In the immediate future our streets and our roads will teem with vehicles for every required purpose, driven by motor power of every desirable kind, and easily controlled and guided by one hand.

To-day hundreds of manufacturers here and abroad are battling with the problems confronting them. Many of them have already conquered and are producing most excellent and satisfactory vehicles. Others there may be that will drop by the way. Heavy, cumbersome, clumsy and lacking in vital essentials of construction, these curious errors will disappear before they have

fairly come to our view, while newer and better devices will take their place and prove their value. Lightness, strength, simplicity and moderate cost in combination will win the battle, and the survival of the fittest will be the result. Some there are who halt when they see the superior work of their competitors, but it cannot deter the ultimate success of the best. The overstocked company with a brilliant prospectus but no money in its treasury, and no plant to manufacture, is doomed to an early death. Capital in plenty will continue to find investment in worthy concerns, and the close of the present year will see the automobile industry a child grown to vigorous manhood.

Automobile Traction

The present season will be likely to witness a wide extension of the automobile "sphere of influence." Probably the most notable direction in which mechanical traction will appear in evidence will be in the realization of the omnibus lines projected in various great cities—as described in the leading article of this issue. These will put the motor-vehicle on a nickel-basis and for the first time give the mass of the population in those cities the practical benefit of the innovation. Moreover the plying of the omnibuses at frequent and stated intervals along regular routes will contribute extensively toward familiarizing the public with the new form of locomotion and establish its popularity. In the way of the transportation of goods and parcels, we may look for a great increase in the use of the automobile for delivery service and postal purposes—uses that have been parallel in their development with that of the automobile for private use and for cab and livery service. We shall scarcely be likely to witness anything this year beyond the experimental stages in the very important field of heavy traffic, such as motor-trucks, carts, etc., and also the various municipal applications—beside the horseless steam-fire engine—like automobile street-sweepers and sprinklers. With these fields practically covered, as they must be in a comparatively near future, the automobile will proceed to enter completely into its own, and rapidly realize all the most confident expectations.

No Closed Season

Before electric traction for street railways had passed the experimental stage it was feared that the problem of snow in our Northern cities would prove an insuperable obstacle. Experience showed, however, that not only was electric traction im-

mensely ahead of animal traction at times of heavy snow, but that electric cars found little trouble even from storms that pretty generally blockaded the steam railroads. This winter has not been of a nature to subject the automobile to severe tests, but there has been at least one snowstorm hard enough to indicate their qualities at such times. And it was found that the automobile, as a rule, did better than the horse. Its broad pneumatic tires gave it a good tread in the snow and enabled it to get through the drifts with little difficulty. Of course the work required much more power than for ordinary running, and electric vehicles had to make much more frequent trips to the stables for recharging. But in general, all classes of automobiles, whether driven by electricity, steam, or gasoline, had sufficient reserve power to meet the increased demands upon their strength. So there is not much to be feared on the score of snow. There is comparativly little call for pleasure-vehicles, either with animal or mechanical traction, in the cold months. Possibly some time we shall achieve an automobile sleigh, and until then a sleigh in tow of the wheeled motor-vehicle may be made to answer! And so far as ordinary traffic is concerned, the snow is now so quickly removed from city streets, and even the country roads are so soon broken out, that the automobile will be found to answer, on the average, all the winter demands, even better than does the horse.

Carriage Builders Needed

It is evident from the new automobile departments in the trade organs that the makers of carriages, as well as the dealers, are paying more and more attention to the possible inroads threatening their industry by this newcomer in their field—the automobile. In this connection we draw attention to the remarks of Mr. W. N. Fitzgerald at the last annual convention of carriage dealers, the substance of which we reproduce in this issue. It is undoubtedly a fact that much of the delay in this year's output of automobiles has been caused by the mistaken notion that the body of a carriage or wagon should be turned out by the hands of the same skillful mechanician that evolved the complicated machinery of the driving gear and motor. As a result we see powerful motors coupled with clumsy vehicles, which, at best, only bring down upon themselves that awkward circumlocution "the horseless carriage."

They do these things differently in France. There, after making the same mistake, the leading automobile constructors

learned the wisdom of profiting by the experiences of others, and accordingly the most popular types of French automobiles are now constructed by the motor engineer and the carriage maker working in conjunction.

Accessory Makers in the Dark

The disadvantages of our system of single-handed manufacture are obvious. Of three hundred and odd American manufacturers of automobiles, as enumerated in a recent English trade manual, barely half a dozen have their products in general evidence. These are the well-known Electric Vehicle Co., the Locomobile Co. of America, the Oakman Motor Vehicle Co. of New England, and two or three other equally well-known automobile makers. As a result of the protracted delay in the output of the other manufacturers, another industry which might be flourishing is floundering in the same slough of despond. This is the industry of automobile accessories, the possibilities of which may be judged from the rapid rise and profits of wheeling accessories which followed upon the general boom of the bicycle business a few years ago.

As matters now stand, those who would produce serviceable accessories for automobiles, such as gear-chains, driving belts, solid rubber rims and pneumatic tires, must needs resign themselves to await the adoption of some more or less general standard which will enable them to get some idea "where they are at." At present most of them, while valiantly trying this and that experiment, actually do not know what is really wanted.

Hints from Abroad

In the meanwhile some of the more enterprising manufacturers of automobiles abroad are improving the occasion by launching their best products in this country. In view of the all but prohibitive tariff levied on these importations this need not necessarily cause concern to our American builders of automobiles. On the contrary, a direct benefit to them must result from the searching tests to which all these foreign automobiles and their accessories are bound to be subjected.

A case in point was the series of trials conducted by various American experts with that recent German importation known as "Vollmer's Forecarriage." The American Express Co. had the Forecarriage hitched to one of their common delivery

wagons, and, with a load of one ton, drove the machine from New York City into Westchester County, taking all grades without any hitch and covering the distance of a little over seventeen miles in less than two hours. The officials of the American Express Co., under whose directions these trials were made, pronounced themselves fully satisfied with the results.

Coming Shows

The proposed automobile exhibitions in Amsterdam this March and in Paris next month should not be overlooked by American manufacturers. Some of them have achieved admirable results in their work of the past year, and in consequence the automobile has approached very considerably nearer the ideal. They should therefore not fail to make a showing of what they have accomplished. Though they may now be so rushed with work that they do not consider it worth while to attract more attention to the merits of their productions, the increased facilities for production that must come will sooner or later make judicious advertising of all kinds yield profitable returns. No business of any kind is so well established that it can afford to hide its light under a bushel.

Manufacturers who send their products to these expositions will probably have an opportunity to exhibit the same vehicles at the American Automobile Club's show projected for next fall. It has been definitely settled that this is to be an independent show, without reference to bicycles, carriages or other allied industries. What remains in doubt is whether it be held as an indoor exposition within the familiar precincts of New York's Madison Square Garden, or as an open air exposition with a more extensive track whereon to display the speeding capabilities of American automobiles. Those who favor the indoor project claim that the repeated failures of open air horse shows in New York have demonstrated that New Yorkers, and those who come to the city on these occasions, do not care for open air affairs. That such need not necessarily be the case, we think, has been abundantly proved by the unfailing popularity of Philadelphia's open air horse show—not to mention the great football games which draw such tremendous crowds, even in the worst of weather. So much is certain: New styles of automobiles, especially those not propelled by electricity, must be shown in the open air, and with plenty of elbow room, to be fully understood and appreciated.

Editorial

Another New Company

Among the many new companies for the manufacture of automobiles which have lately sprung into existence, one of the most promising appears to be National Electric Automobile Co., of Indianapolis. L. S. Dow, the former manager of the Waverly branch of the American Bicycle Company or Bicycle Trust, and latterly the secretary and general manager of the Indiana Bicycle Co., is the promoter of the new enterprise. Associated with him are Arthur C. Newby, the leading spirit of the Indianapolis Chain and Stamping Factory, and Philip Goetz, the probable treasurer.

The company will manufacture electric automobiles and at the same time engage in the making of any other electrical appliances. After the concern is well under way the manufacture of gasoline automobiles will also be undertaken.

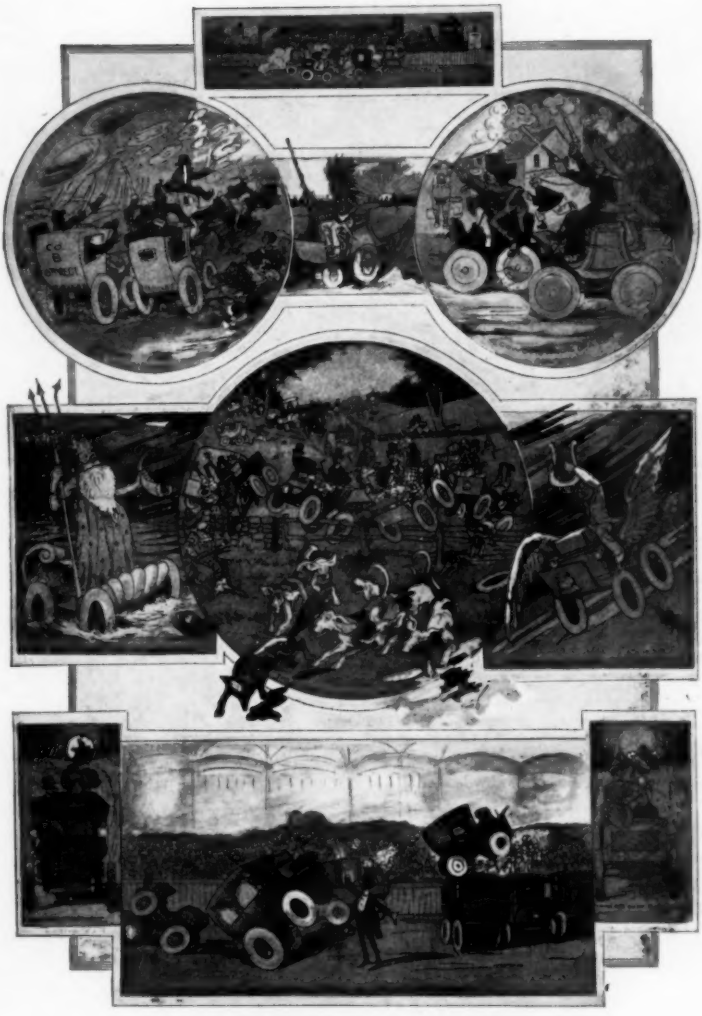
Automobile in a New Role

The automobile, which is becoming so familiar an object on our streets, has already figured in an elopement—so, at least, say the German despatches—and there is every probability that it will prove the vehicle of flight for runaway lovers of the incoming century. Its novelty, its exclusiveness, its speed, its silence, its simplicity in working, must all commend themselves to such as desire matrimonial bliss without the paternal consent. The railway carriage is so public an affair that runaway couples are in constant danger of recognition by friends or acquaintances who are shabby enough to happen on the same train; the horse and carriage affair is risky, because if it is kept too long there is danger of warrants for horse-stealing being issued; and the bicycle, tandem or single, is not a romantic form of locomotion, especially for the girl whose aim is speed. Walking, of course, is out of the question. The automobile, then, seems to be the ideal vehicle for elopers who have been forced to flight by stern parents. Side by side they can sit as they speed onward, the young man's attention only being distracted from his beloved by his being obliged to keep an eye upon the brake, and there is no need of a grinning, horrid coachman.

"Upon her lover's arm she leant,
And round her waist she felt it fold,
As far across the hills they went
Swift as the Valkyries of old."

AN IMPROVISED AUTO CLUB
From the *Deutscher Automobil Sport*

Automobile Humors



WHAT WE ARE COMING TO

From the Comic Section of the *New York Sunday World*

Press Notices and Book Reviews

Not a month passes now-a-days without the appearance of some new periodical publication devoted to the automobile and the new sports and industries that have arisen therewith. Last month brought us two such publications from Austria, one from Germany, and one from Nice, each of them profusely illustrated and full of bounding hopes for the future. Among the new arrivals this month the foremost is No. 1, Volume 1, of *The Irish Motor News,* published at Dame Court, in Dublin. This magazine, which is edited by R. Mecredy, the well-known editor of the *Irish Cyclist,* bids fair to rival some of the best publications that have already become well established in France and on this side of the Atlantic. The *Irish Motor News* indeed can be called a magazine in the American application of that term, which means that the character of its illustrations and letter press and quality of paper are unexceptionable. With these advantages the magazine shares the well-nigh universal defect of so many of our New World publications, to wit, triviality of subject matter and exaggerated attention given to topics of purely local import. Compared to such standard English publications as Mr. Sturmey's *Autocar* and the London *Automotor and Horseless Vehicle Journal,* their new rival across the Irish channel, however promising at first blush, appears somewhat provincial.

Lately the New York *Hub* has gone into automobilism. Specially noteworthy was what the editor of the *Hub* had to say on the subject of the so-called automobile exposition held in New York in January:

"There was a very general feeling of disappointment among those who attended the late show at Madison Square Garden, on seeing so small a number of exhibits of automobiles. The daily press had published glowing statements and promised the largest show of motor vehicles ever held in this country, and in addition stated that every prominent manufacturer of automobiles in the country would be present with his best products. The latter statement was true with those who did exhibit, but ten exhibitors could not be expected to make a great show. Then, too, the exhibits were so scattered as to make the show appear less important than it actually was. If automobile manufacturers are to have an exhibit that will do credit to them, they must cut loose from the bicycle. Go it alone, you who exhibit automobiles. Don't stifle the life of a new industry by hitching it to the carcass of a dead one."

Press Notices and Book Reviews

Les Moteurs à Explosion, Etude a l'usage des Constructeurs et Constructeurs d'Automobiles, par George Moreau, is a work issued by the publishing house of Béronger in Paris, a brief mention of which has already been made in the index of this magazine. M. Moreau's work is a study of explosion motors from the point of view of a theoretical mathematician. The author begins with a treatise of the physical and mathematical principles that govern explosion motors and then proceeds to the momentous subject of mechanical equivalents of heat. This is a subject that has been discussed so thoroughly during the latter part of this century that it would seem impossible to treat it from a really novel point of view. Yet the author seems to have succeeded in this, at least so far as it concerns explosion motors and the mechanical transmission of energies. In connection with his theories of the mechanical equivalents of heat, M. Moreau takes up the much-discussed theory of gases, in the study of which he goes back as far as Sadi Carnot, the famous author of the French law on the preservation of power. This is followed by general reflections on the accepted theories of motors and practical illustrations of the most recent diagrams and the loss of gases. An important chapter is that on power transmission and the theory of passive resistance, such as the resistance of air, effects of wind, axle friction and the resiliency of automobile tires. Of practical interest is the author's estimate of the various materials suitable for the manufacture of motors and the theoretic principles that should govern their selection. The work ends with a highly interesting contribution on the best fuels and gases that can be used for explosion motors.

A valuable publication is the "Automobile Pocket Book," issued by F. King & Co., the publishers of the *Automotor and Horseless Vehicle Journal,* in London. Mr. George Frederick Little, who has compiled this manual, is an experienced engineer and editor who has succeeded in grouping together all the most important subjects bearing on automobiles and everything connected with them in so lucid a manner as to make the book invaluable for quick reference. Besides an alphabetical index, giving all the subjects treated throughout the three hundred and odd text pages, there is a very serviceable glossary of all the most current automobile terms used in French, German and English.

The book is plentifully supplied with tables of comparative weights and measures, pressures of steam, metal expansions, speed tests, records and the powers and roots of numbers and

logarithms. Of special interest for English purchasers are the lists of regulations and laws relating to motor vehicles and those for securing patents on new inventions in the United Kingdom. More general in its interest is the complete list of British and foreign manufacturers and engineers, with directories of all automobile clubs and publications now existing in Austria, Belgium, France, Germany, Great Britain, Holland, Italy, Russia, Spain, Switzerland, and in the United States. American readers will be interested in the final ten pages of the book giving the names and local *habitat* of all the more prominent American firms of automobile manufacturers. They number nearly 300 in all.

Die Automobilen, ihr Wesen und ihre Behandlung, written by Dr. E. Möllendorf, with Capt. F. Kübel, and published by George Siemens in Berlin, is an excellent little hand book with many highly serviceable illustrations. The book is written for lay readers and is of interest to all who are concerned with the operation and manufacture of automobile vehicles.

After a brief preface and an historical review, the authors furnish a lucid treatise on the elementary principles of motors and on the general operation, cost and use of automobiles.

This is the first comprehensive work on this subject made intelligible to the general reader, that has appeared in Germany, and is bound to become something of a standard among German motor men who are not professional engineers. If certain parts of the text were adapted to American conditions, it might well be worth while to translate this excellent little hand book into English.

Das Automobil in Theorie und Praxis (Elementarbegriff des Fortbewegungsmittels mechanischer Motoren) is a German translation of the well-known French work by L. Baudry de Saunier. This authorized translation has been competently handled by Dr. R. von Stern and is published by A. Hartleben in Vienna.

As the original French edition has already been reviewed in these pages, it is scarcely necessary to enter into details of its German successor. Suffice it to state that the translation appears to be faithful and felicitous in many respects, while some of the illustrations appear even better than they did in the original.

The Automobile Index

Everything of permanent value published in the technical press of the world devoted to any branch of automobile industry will be found indexed in this department. Whenever it is possible a descriptive summary indicating the character and purpose of the leading articles of current automobile literature will be given, with the titles and dates of the publications.

Accumulators—

A serial article. by E. C. Bimington, on the construction of accumulators for automobiles. "The Automotor Journal," London, January, 1900.

Acetylene Bicycle—

Description and illustration of an acetylene motor applied to bicycle propulsion, devised by C H. Offen. "La Locomotion Automobile," Paris, January 4, 1900.

Aluminium—

"The Present Uses of Aluminium" An article by Leon Auscher. "The Automobile Magazine, February, 1900.

Automobile Postal Service—

An article, with illustrations, by Perry S. Heath, First Assistant Postmaster General. "The Automobile Magazine, February, 1900.

Automobilism in 1899—

A review under the title of "The Progress of Automobilism in 1899." With illustrations. "The Motor-Car Journal," London, January 12 and 19, 1900.

Carbureters—

Illustrated description of the Lambert Carbureter. "La Locomotion Automobile," Paris, December 28, 1899.

Description of the new carbureter, patented by E. Georis, of Charleroi. "La Locomotion Automobile," Paris, January 4, 1900.

The Eldin carbureter described and illustrated. "La Locomotion Automobile," Paris, January 4, 1900.

Coils and Sparks—

A study by E. J. Stoddard. With diagrams. "The Horseless Age," New York, January 17, 1900.

Compressed Air in Europe—

A full description of the compressed air motor used for the propulsion of the Molas, Lainielle & Tessier delivery wagon "The Automobile Magazine," February, 1900.

Construction—

Recent Progress in Automobile Construction. W. Worby Beaumont. A review of the progress in details of motor vehicle construction during the past two years, showing the lines of advance in the removal of the mechanical imperfections revealed by experience. "Engineering Magazine," January, 1900.

Couthon's Automobile—

A relique of the last century briefly described. With illustrations. "The Automobile Magazine," February, 1900.

Electric Automobiles—

An article, by Frank B. Rae, on the design and control of electric-motors. With illustrations. "The Motocycle-Automobile," Chicago, January, 1900.

Description of the Rae carriage and its motor. With illustrations. "The Motocycle-Automobile," Chicago, January, 1900.

Illustrated description of a new electric carriage, built by Mr. Carl Opperman, of London. "The Automotor Journal," London, January, 1900.

The Automobile Magazine

Electricity on Common Roads—

A paper read by Mr. Thomas H. Parker, of Wolverhampton, before the Automobile Club of Great Britain. With three illustrations. "The Motor-Car Journal," London, January 12, 1900.

Electric Fore-carriage—

Description of the Solignac electric front hauler. With two illustrations. "La Nature," Paris, January 13, 1900.

Electric Motors—

An illustrated article, by F. B. Rae, on the design, construction and control of electric motors. "Electrical World and Engineer," New York, January 20, 1900.

The "Electromobile Ambulance," built by F. R. Wood & Son, of New York, for St. Vincent Hospital service. "Electrical Review," New York, January 24, 1900.

Fore-carriages—

"A Front-driven, Front-steered Automobile." Description and illustration of a new fore-carriage. "The Automobile Magazine," February, 1900.

Gas Motors—

Description of the reversible gas motor invented by Macdonald and Mackenzie, of England. "The Automotor Journal," London, January, 1900.

Gasoline and Gasoline Mixtures—

An illustrated article by E. J. Stoddard. "The Horseless Age," New York, January 17, 1900.

Gasoline Vaporizers and Carbureters—

A study by Henry W. Struss. With illustrations. "The Horseless Age," New York, January 17, 1900.

Heavy Motor Wagons for Liverpool Traffic—

A paper read by Mr. Arthur Musker before the Liverpool Engineering Society. With 11 illustrations. "The Automotor Journal," London, January, 1900.

Hydro-carbon Automobiles—

The Plass voiturette described and illustrated. "La Locomotion Automobile," Paris, December 28, 1899.

The new model "Locomobile" carriage for 1900 described and illustrated. "The Motocycle-Automobile," Chicago, January, 1900.

The Wellington "Automobilette" described and illustrated. "The Automotor Journal," London, January, 1900.

A brief description of the new automobile built in Austria by the "Nesselsdorfer Wagenbau-fabriks Gesellschaft." "The Motor-Car Journal," London, January 5, 1900.

Brief description of latest improvements made on the Decanville carriages. Two illustrations. "La France Automobile," Paris, January 7, 1900.

The new Bollée voiturette described. With five illustrations. "La France Automobile," Paris, January 7, 1900.

A brief description of Luap-Legendre's "Mignonette." One illustration. "Le Chauffeur," Paris, January 11, 1900.

The Turgan-Foy carriage fully described and illustrated. "La Locomotion Automobile," Paris, January 11, 1900.

The voiturette called "La Princesse" (Barisien system) described and illustrated. "Le Chauffeur," Paris, January 11, 1900.

Illustrated description of the Levenn voiturette as built by Ernest & Co., of Paris. "The Motor-Car Journal," London, January 12, 1900.

Description of a two-seated phæton designed and built by Mr. Sutton, of Melbourne, Australia. "The Autocar," Coventry, England, January 13, 1900.

A full description and illustration of the Underberg voiturette. "La France Automobile," Paris, January 14, 1900.

Description of the "Eureka" carriage, built by Ough & Waltenbaugh, of San Francisco, Cal. With six illustrations. "The Horseless Age," New York, January 17, 1900.

The Automobile Index

Hydro-carbon Motors—

Illustrated description of the "Minerve" motor. "Le Chauffeur," Paris, January 11, 1900.

An illustrated description of the Bravo gasoline motors. "The Automobile Magazine," February, 1900.

Ignition and Ignition Troubles—

An illustrated article on this subject by P. M Heldt. "The Horseless Age," New York, January 17, 1900.

Ignition Verifier—

A device to verify electrical ignition on the hydro-carbon motors. Described by Gustave Hermite. One illustration. "La France Automobile," Paris, January 7, 1900.

Improvements in Internal Combustion Motors—

Description and illustration of the improved Crossley and Atkinson's motor. "The Automotor Journal," London, January, 1900.

Les Automobiles de Guerre—

An article pointing at the advantages of the Scotte traction engine as a hauler of trains of cars loaded with guns and other heavy materials of war. With four illustrations. "La Nature," Paris, January 6, 1900.

Lubricators—

Illustrated description of the Serpollet lubricator. "The Automobile Magazine," February, 1900.

Mechanical Propulsion and Traction—

A serial paper by Prof. G. Forestier. "The Automobile Magazine," February, 1900.

Motor Carriage Experiments—

An article on care and management of automobiles. By Mr. John Pope, of Liverpool, Eng. "The Autocar," Coventry, January 6, 1900.

Motor-Omnibus Lines—

Ideas on the possibilities of motor-vehicles in inter-urban passenger transportation compared with trolley lines. "The Motor Age," Chicago, January 18, 1900.

Motor Racing—

An article, with illustrations, by Edwin Emerson, Jr. "The Automobile Magazine," February 1900.

Multi-Cylinder Engines—

An article by P. M. Heldt. "The Horseless Age," New York, January 17, 1900.

Official Time-keeping Rules—

An article, by G. H. L. "The Automobile Magazine," February, 1900.

One Year's Progress of Automobilism—

An article by Prof. Félicien Michotte. With illustrations. "The Automobile Magazine," February, 1900.

Racing Rules—

The French racing rules (official). "The Automobile Magazine," February, 1900.

Radiators—

Illustrations and brief description of the Apprin radiators. "Le Chauffeur," Paris, January 11, 1900.

Speed Changing Gear—

Speed changing by means of extension pulleys. Lepillet's system described and illustrated. "La Locomotion Automobile," Paris, January 4, 1900.

Illustrated description of the "progressive" speed changing gear devised by Mr. H. Gérard. "La France Automobile," Paris, January 11, 1900.

A new speed changing gear for tricycles and voiturettes. Metz system described and illustrated. "L'Industrie Automobile," Paris, January 25, 1900.

Gaillardet's speed-changing gear, described and illustrated. "The Automobile Magazine," February, 1900.

The Automobile Magazine

Starting Device—

"An Automatic Starting Gear for Hydrocarbon Motors." With illustrations. "The Automobile Magazine," February, 1900.

Steam Automobiles—

"The Locomobile." An article describing the latest modifications and improvements made in the locomobile carriages. "The Automobile Magazine," February, 1900.

Steam Generators—

Illustrated description of the Blaxton steam generator. "The Automotor Journal," London, January, 1900.

Steam Lorry—

Full description of the Simpson-Bodman steam lorry. With seven illustrations. "The Motor-Car Journal," London, January 12, 1900.

Steering—

An article by R. D. on steering by means of the divided axle devised by Ph. Marot-Gardon et cie. "La Locomotion Automobile," Paris, January 18, 1900.

Steering Mechanism—

Illustrated description of the new Dion-Bouton steering mechanism. "La France Automobile," Paris, January 18, 1900.

Strength of Steel Balls—

A paper read before the December meeting of the American Society of Mechanical Engineers, by J. F. W. Harris. "The Motor Vehicle Review," Cleveland, O., January 23, 1900.

The Automobile in Local Transit—

An article by Sylvester Baxter. "The Automobile Magazine," February, 1900.

The Automobile Movement—

An article, by M. C. Krarup, on the styles of vehicles required and the usefulness of separate tractors. "American Machinist," New York, January 25, 1900.

The Construction of a Gasoline Motor Vehicle—

A serial technical article by Clarence C. Bramwell. "The Motor Vehicle Review," Cleveland, O., January 30, 1900.

The Gasoline Engine Indicator Diagram—

A study by E. C. Oliver, Engineering Department, University of Illinois. "The Horseless Age," New York, January 17, 1900.

The Use of Balls in Motor Construction—

An article by H. B. Adams. With illustrations. "The Motor Vehicle Review," Cleveland, O., January 23, 1900.

The Vibration of Explosion Motors—

An article by Herbert L. Towle With illustrations. "The Horseless Age," New York, January 17, 1900.

Traffic Regulations and the Speed of Motor Vehicles on Highways—

A paper read before the Automobile Club of Great Britain, by R. E. Crompton. "The Horseless Age," New York, January 10, 1900.

Transmission Gear—

The transmission gear adopted by the "Société Française d'Automobiles." A brief description, with one illustration. "L'Industrie Velocipédique et Automobile," Paris, November, 1899.

Trials—

The Liverpool trials of motor vehicles. Judges' report, with illustrations. "The Automotor Journal," London, January, 1900.

Competitive trials of hydro-carbon motors in Paris, under the management of "La Locomotion Automobile." Described and illustrated. "La Locomotion Automobile," Paris, January 4 and 11, 1900.

Vaporizers and Carbureters—

An article, by Herbert L. Towle, on the requisites and action of vaporizers and carbureters. "The Horseless Age," New York, January 17, 1900.

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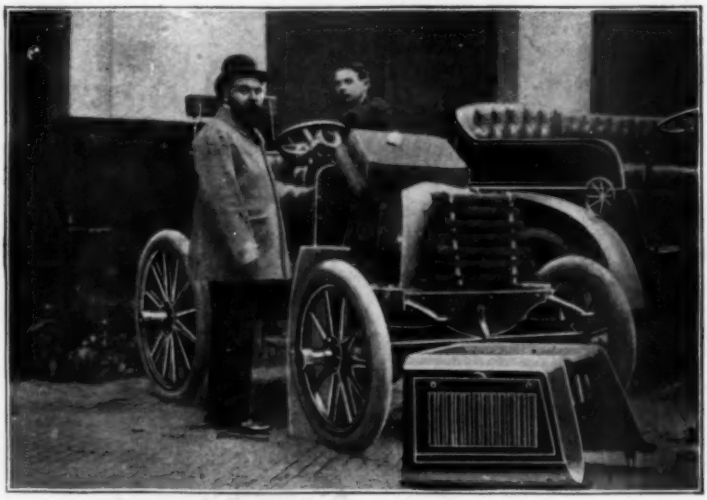

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Fitted with a two-speed gear, of extremely simple construction, by which means almost any hill can be ascended when the machine is carrying two persons. This gear also allows of the motor being entirely thrown out of gear when not required, and the machine can then be easily pedalled or moved about, an advantage that cannot be too highly recommended, as the motor can be kept running when in heavy traffic, or in any circumstance requiring a sudden stop. The motor is a genuine "De Dion," with electric ignition, and capable of travelling at a high rate of speed. The frame is very strongly constructed and is made of metal throughout. Both front and rear seats are extremely comfortable, and the steering very easy, and the cost of spirit for driving can be taken at about ¼d. per mile. The front seat is comfortably upholstered and provided with a leather apron. The front wheels are 26 in. diameter and the rear 28 in.

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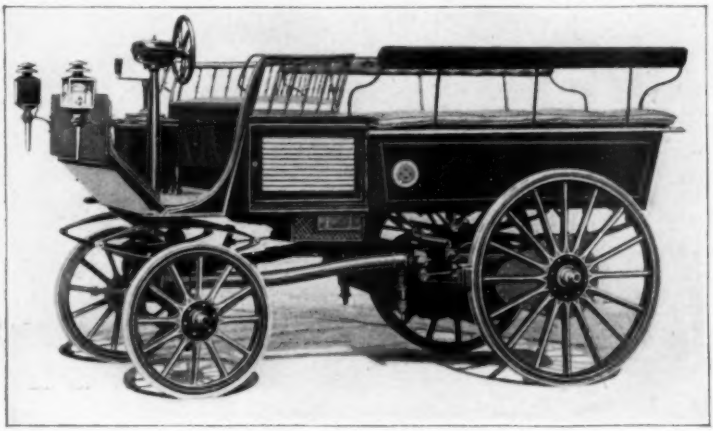

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Carriages with 5 to 12 horse-power motors with flange-cooled cylinders.

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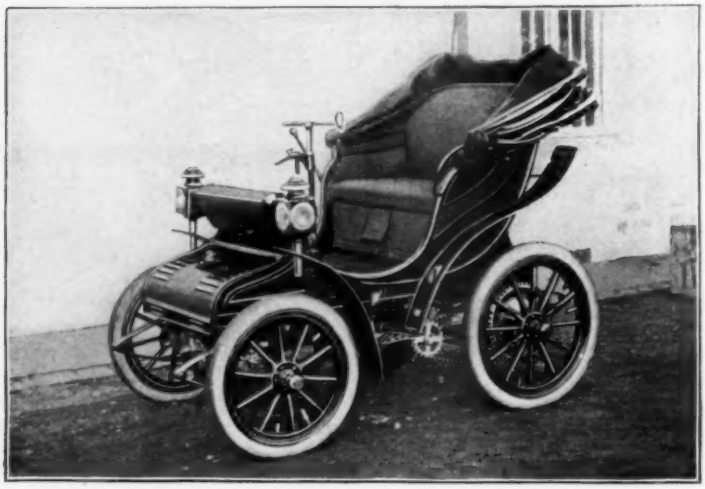

The only carriage with an 8 horse-power motor not cooled by a water-jacket, which took part in the Paris-Bordeaux race, was a Henriod Carriage that made 321 miles in 19 hours.

These motors are vapor, petroleum, and alcohol engines.

Carburation is effected by means of a vaporizer.

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Supplied with or without Hood, which is detachable

MORE doctors are users of this car than all other patterns put together. It is extremely reliable, very comfortable, and economical in use. It is a handsome carriage, and a credit to its owner and user. It will mount the steepest hills with ease, and can travel at a great speed on the level. It will carry enough oil for two hundred miles, and cannot catch on fire or explode. Over 1,600 of these motors are in use on the Continent and in England.

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A Treatise on Automobiles

IN FRENCH

BY

LOUIS LOCKERT

Graduate-Engineer of the École Centrale des Arts et Manufactures

Delegate of the Touring-Club, Member of the Automobile-Club

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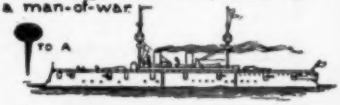

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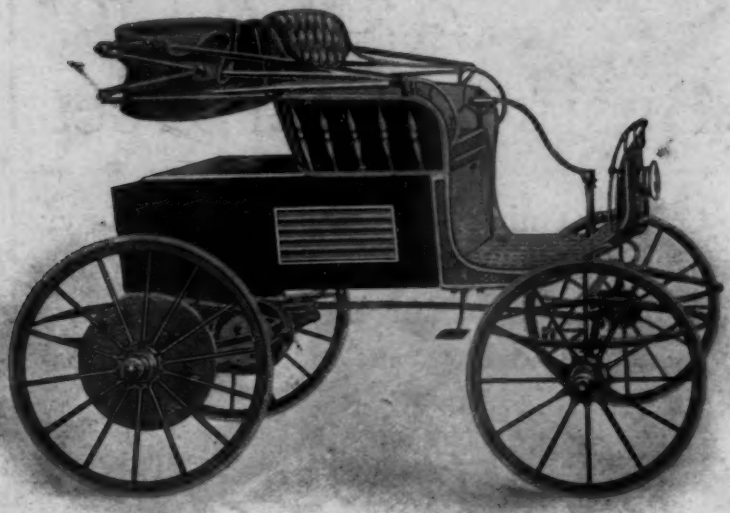

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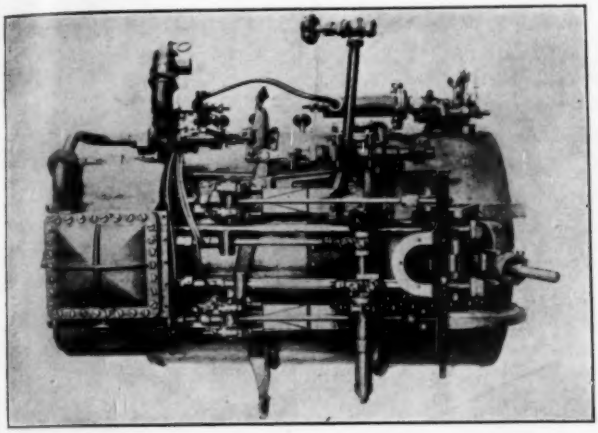

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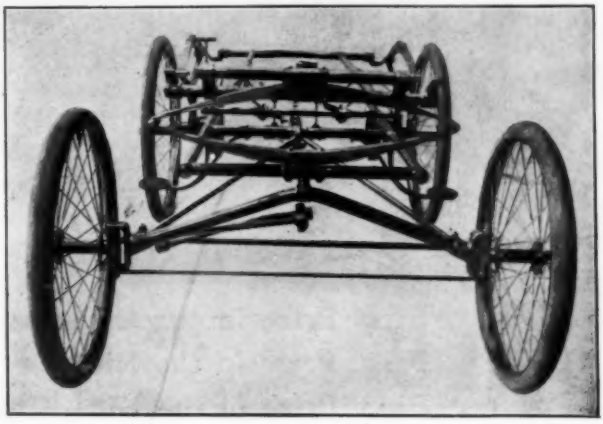

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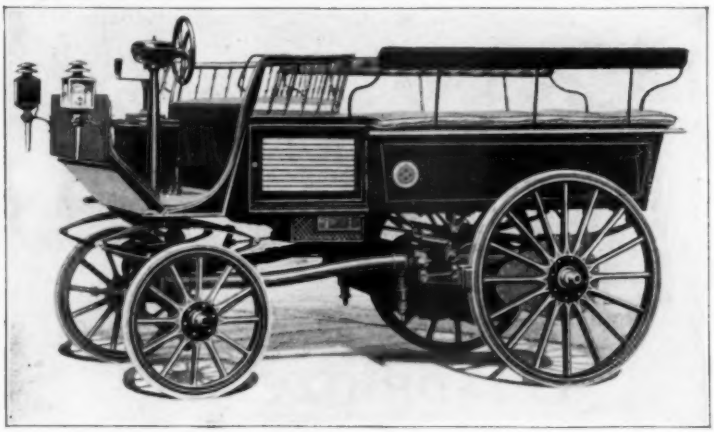

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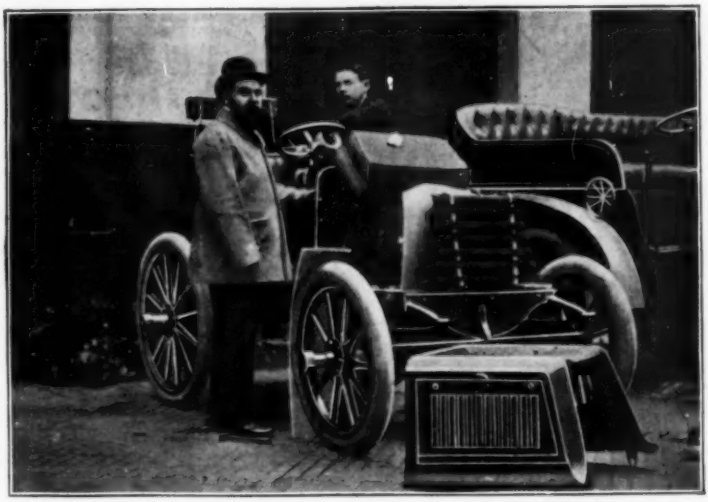

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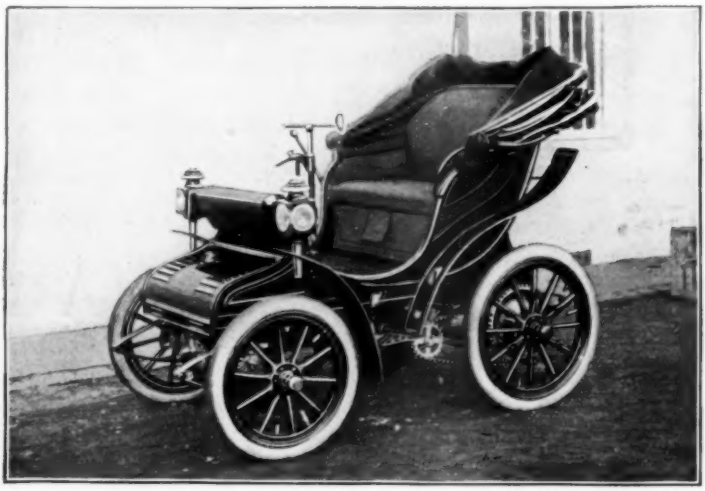

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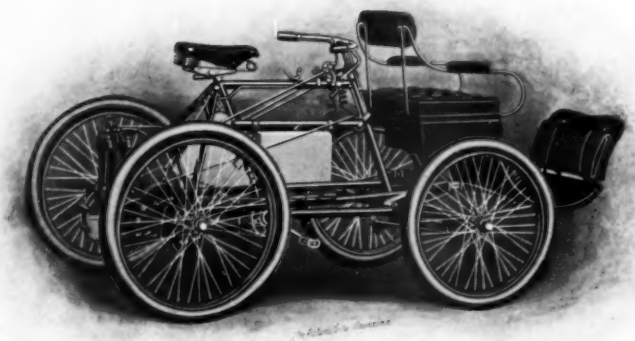

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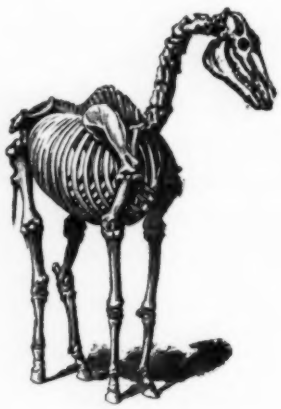

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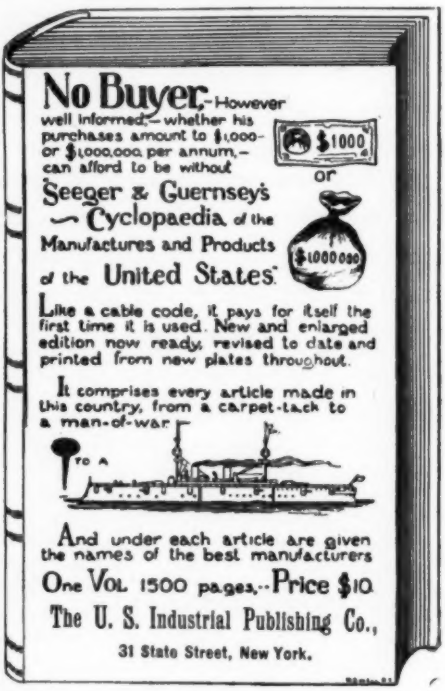
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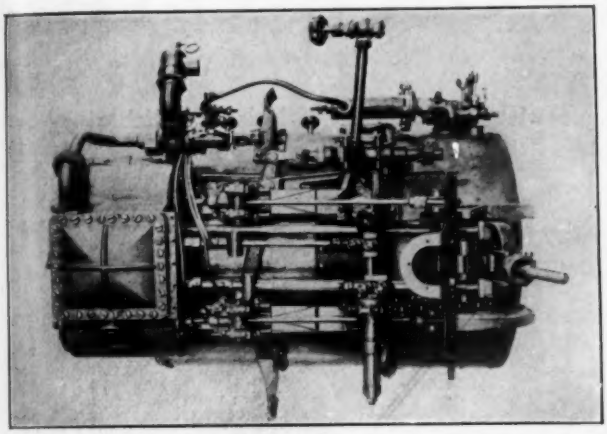

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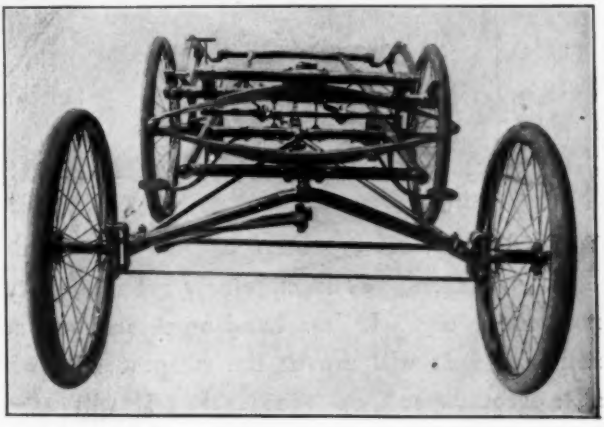

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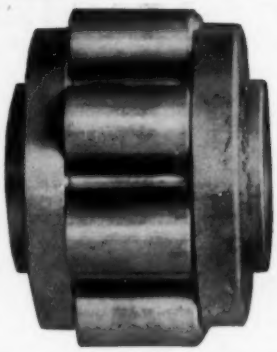

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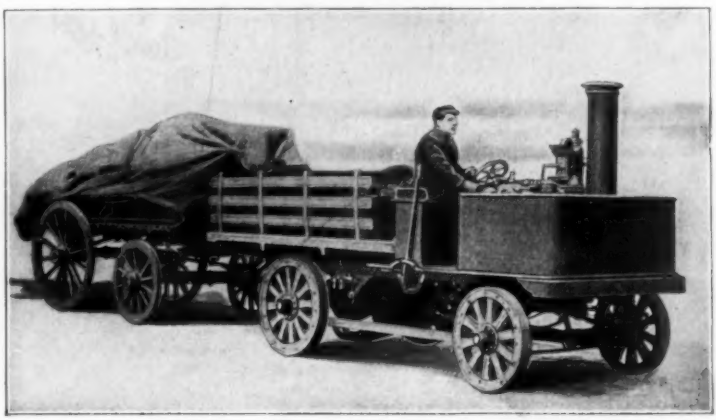

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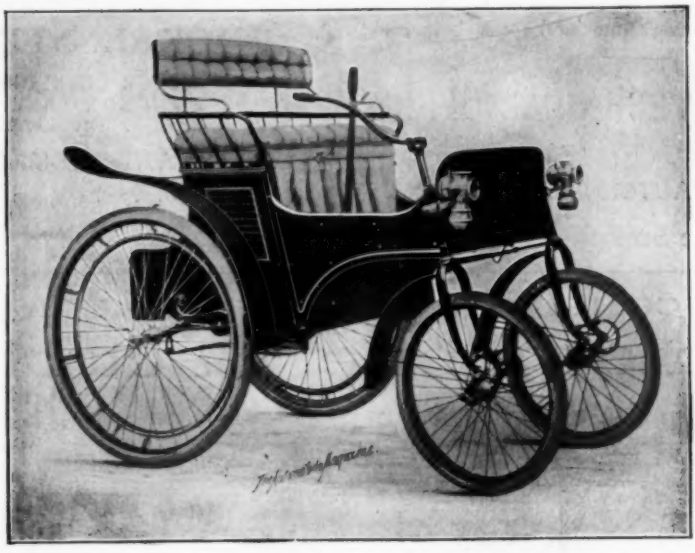

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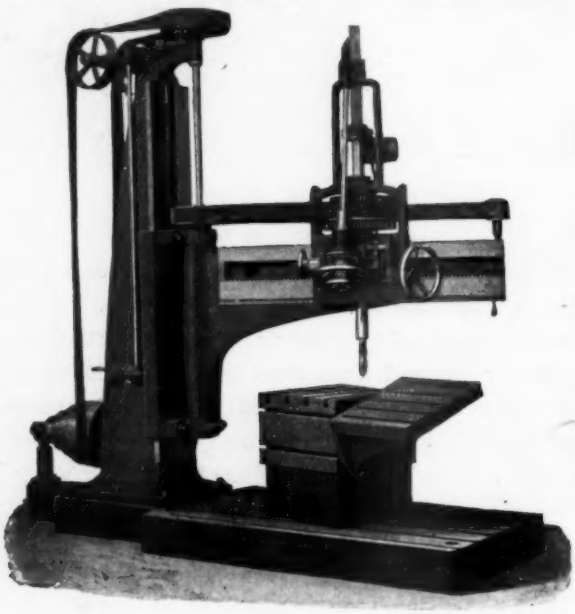

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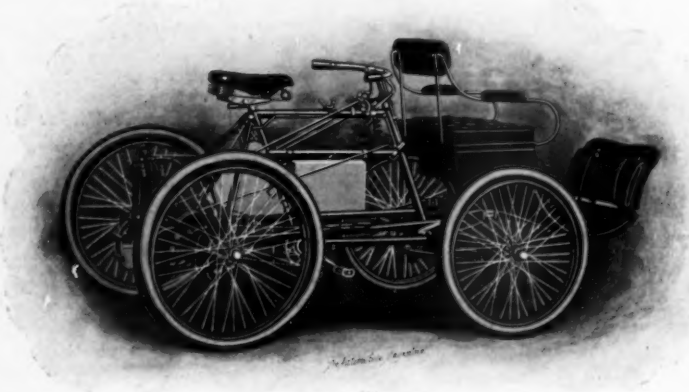

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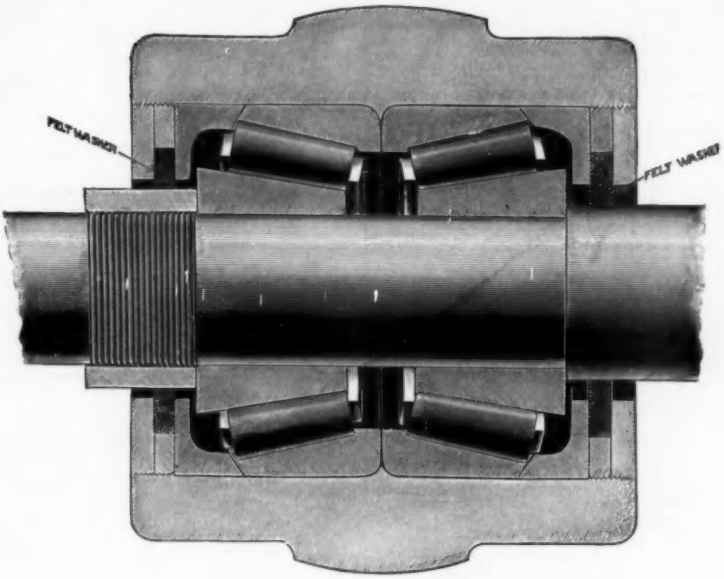

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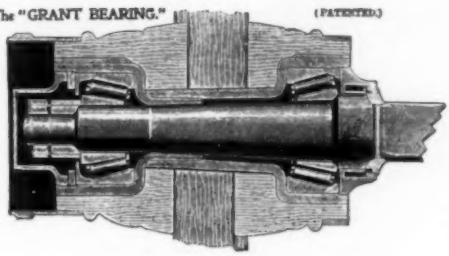

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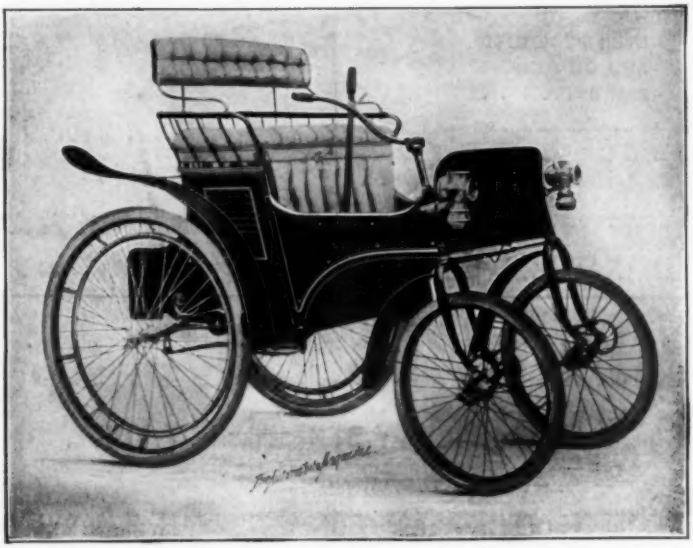

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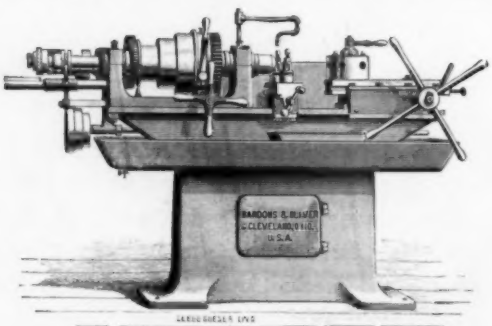

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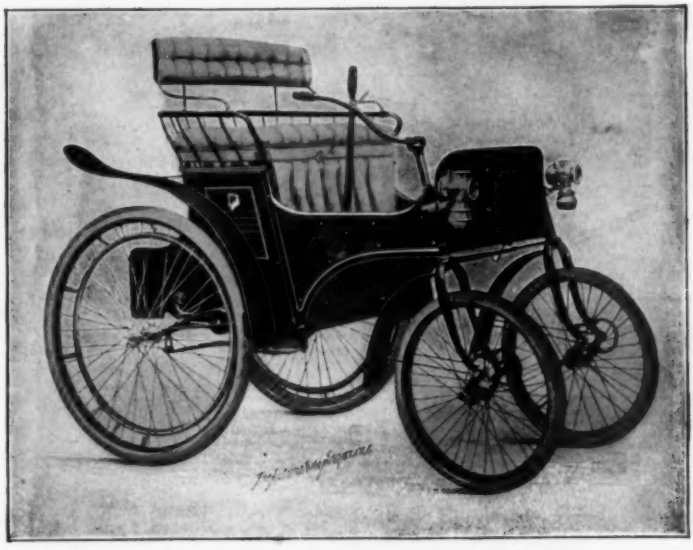

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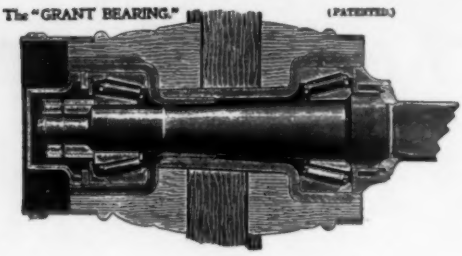

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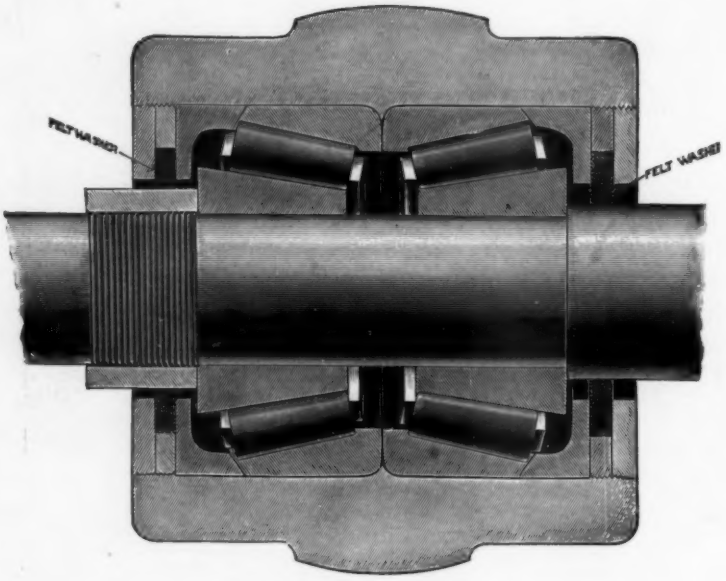

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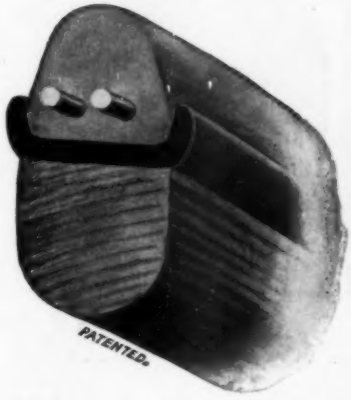

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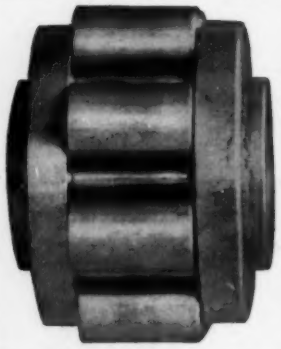

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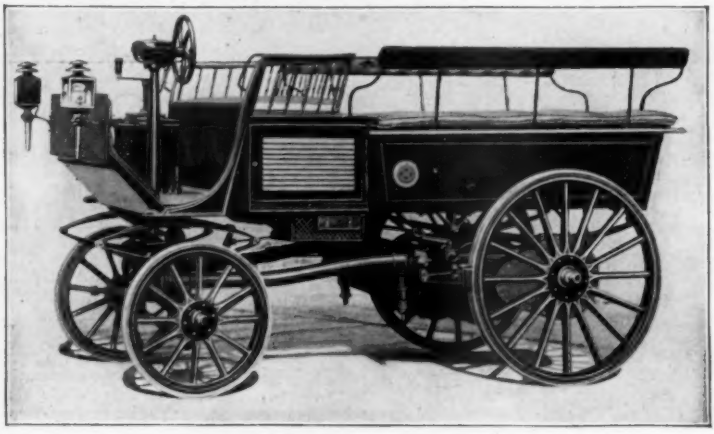

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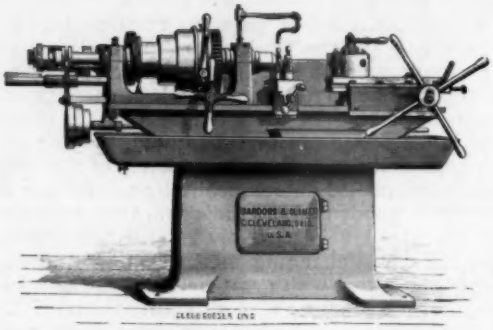

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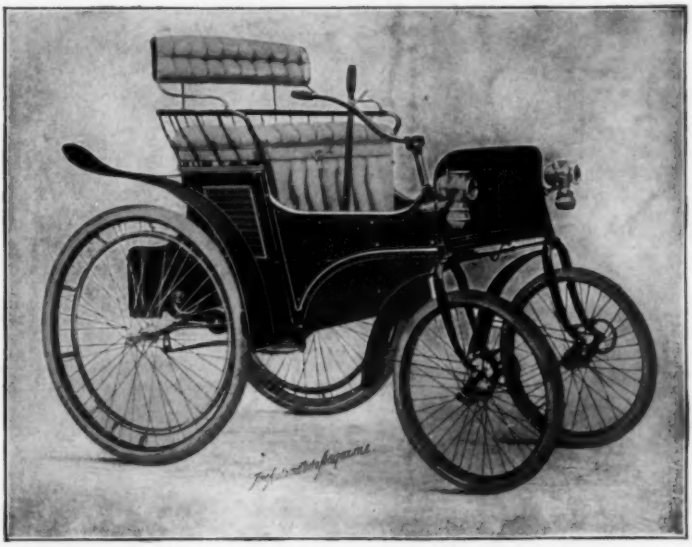

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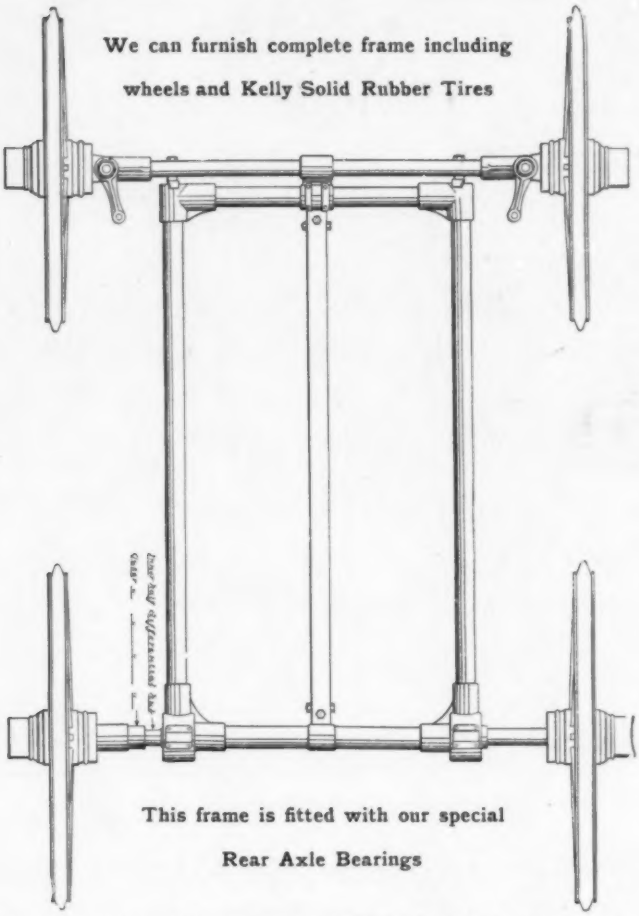

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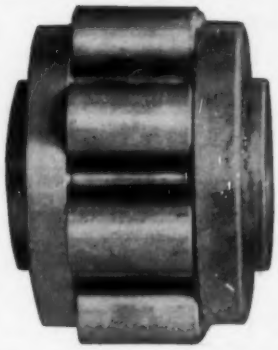

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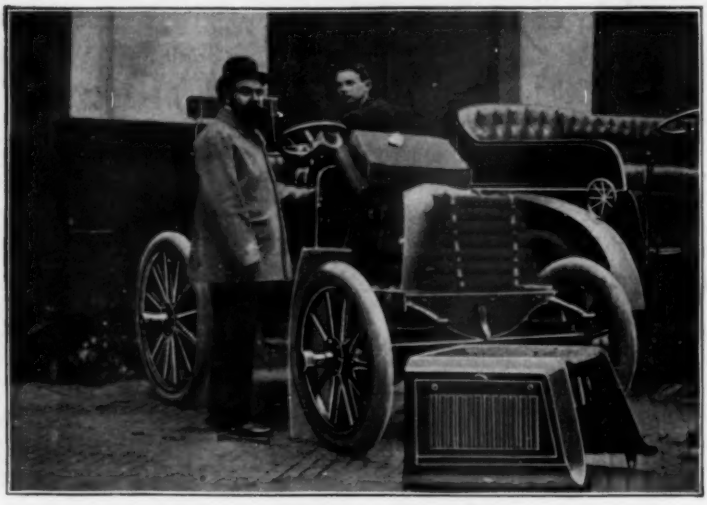

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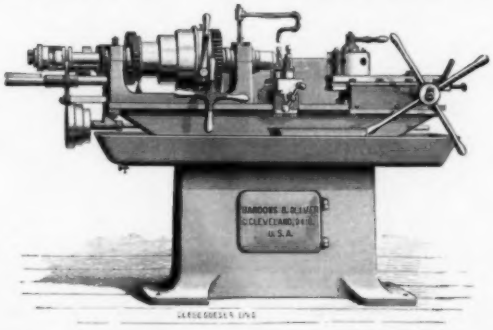

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